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AVIATION AND COSMONAUTICS

No 10, October 1989

Air Force Engineer Service Problems Reviewed

90R10007A Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 10, Oct 89 (signed to press 12 Sep 89) pp 1-3

[Interview with Col Gen Avn V. M. Shishkin, chief engineer of the Air Force, by editors of AVIATSIYA I KOSMONAVTIKA: "Emphasis on Problems of Quality"]

[Text]

[AVIATSIYA I KOSMONAVTIKA] Comrade Colonel General, the USSR Congress of People's Deputies has reconfirmed a policy of further strengthening this country's defense capability on the basis of improving the qualitative parameters of Armed Forces organizational development both as regards military science and technology and personnel. This point unquestionably presupposes restructuring of the activities of Air Force personnel and the style of command and control of Air Force units. How is this process proceeding in the Aviation Engineer Service which you direct?

[Shishkin] First of all I must note the great political importance of the party's firm position focused on ensuring effectiveness of military organizational development primarily by means of qualitative parameters. This emphasizes our endeavor to put a halt once and for all to the contest in military strength between the opposing sides. This does not mean, however, that we can "rest on our laurels." We must be aware of the fact that ensuring this country's reliable defense capability and security to a reasonable degree and with optimal expenditures demands of us that we ensure that every decision and every program is grounded on the principles of the new thinking, that we take into consideration the actual state of affairs and, most important, foster and promote further increase in vigilance, combat readiness of our military forces, and improvement of all aspects of military affairs on the basis of strengthening the personal responsibility of each and every member of the military for performance of his duties.

As we know, one of our service's principal functions is aviation engineering support in performance of the daily combat training tasks by Air Force units and subunits. Having analyzed the forms and methods of accomplishment of this task as well as increased demands on time and qualitative characteristics, the central administrative staff of the Air Force Aviation Engineer Service has drawn up a plan for improving management of aviation engineering support which, in addition to technical and organizational measures, is based on extensive utilization of computer hardware (personal computers), linked into an integral computerized information system.

In our opinion implementation of this plan will make it possible continuously to possess at all levels precise information on the status of the aircraft fleet, to define in specific terms the functions of the various levels of aviation engineer service control and management, while sharply reducing the flow of directives and other such documents, and also to communicate information on air and ground mishaps to the units in a prompt and timely manner. Extensive utilization of personal computers will ensure accuracy and speed in engineering calculations, correctness of decisions made on the basis of such calculations, more efficient and well-validated structuring of the system of orders for military goods and supplies, and attainment of a qualitatively new level of coordination with rear services agencies in the near future.

The first practical steps have already been taken in the area of computerization of the Air Force Aviation Engineer Service. A number of scientific research projects are in progress, enlisting the services of scientific research institutes, Air Force higher educational institutions, and industry. Corresponding work in the line units has been organized. Incidentally, in the units in which the aviation engineer service is headed by officers A. Shelekh, M. Yelkin, V. Zhigachev, V. Belyy, and V. Krasnokutskiy, volunteers are already using personal computers to handle a number of informational and calculation tasks. Their positive experience will be synthesized and utilized throughout the Air Force.

In the area of improving quality and reliability of aviation engineering support, we are counting heavily on transition to a new (with greater autonomy on the part of aviation engineer service subunits) table of organization structure, which presumes more precise organization of work activities in preparing aircraft for flight operations and, most important, attainment of a qualitatively new level of inspection and maintenance of equipment and armament at the line unit level.

Improvement of the system of inspection of aircraft and armament as a basis for decision-making on performance of preventive maintenance procedures, equipment repair or further operation is another most important task. What are the main problems here? On the one hand, aircraft equipment and armament currently being delivered to the units feature modern onboard monitoring systems as well as rather effective means of ground monitoring and processing of flight information and results of weapons delivery. But they require a fair amount of time for processing and qualitative analysis of data. On the other hand we have few performance monitoring teams, which deal for the most part with processing of in-flight information and possess insufficient mastery of modern methods of analyzing the state and condition of aircraft and results of weapons delivery. As a rule subunit engineer and technician specialist personnel are forced to do this work.

The inadequate reliability and work volume capability of ground information processing systems as well as deficiencies in a number of automated processing programs constitute a major impediment to further improvement of the quality and reliability of aviation engineering support.

[AVIATSIYA I KOSMONAVTIKA] What specifically is being done at present to correct these deficiencies?

[Shishkin] We have drafted proposals, based on the actual state of affairs, pertaining to adoption of a uniform system of analysis and assessment of the state and condition of aircraft, which provides for a three-stage monitoring and inspection procedure. This includes an onboard system, using built-in monitoring systems (VSK) and automated monitoring systems (ASK); maintenance inspection between flights, performed by an enlarged performance monitoring inspection team (including a specialist in aerodynamics and specialists in analysis of weapons delivery results and aircraft operation); base inspection, in a subunit attached to the Air Force regiment aircraft maintenance unit. By equipping such a subunit with new, high-output Mayak-85, Luch-71M K2, and Luch-90 data processing systems, we can more thoroughly analyze the state and condition of aircraft and aircraft equipment, and we can amass statistical material (database) enabling one to take into consideration an aircraft's individual peculiarities and, as a consequence, to transition to scientifically-validated maintenance based on "technical conditions." The reduced labor expenditures on performing routine scheduled maintenance and all types of periodic maintenance procedures must be refocused toward increasing the capabilities of the regimental aircraft maintenance unit to repair fixed-wing and rotary-wing systems and components, streamlining the workday, and improving organization of labor. In addition, scientific research establishments, Air Force higher educational institutions, and industry are working on the development and adoption of powerplant graphic analysis and condition evaluation programs.

[AVIATSIYA I KOSMONAVTIKA] Are Air Force innovators making a certain contribution toward accomplishing the tasks assigned to the Aviation Engineer Service?

[Shishkin] They certainly are. The tens of thousands of Aviation Engineer Service specialist personnel, who every day perform an enormous volume of work on aircraft equipment, of course constitute the principal motive force in its improvement in a design and operational respect. Unfortunately, however, efficiency innovation and invention activity at the unit level is not always adequately coordinated from the higher echelon.

Certain changes for the better have occurred in this area. But there still remains a great deal of parallelism and excessive diversity of topics. A large number of research projects and technical proposals have not yet found practical embodiment. Lying hidden behind a substantial volume of efficiency innovation proposals at the unit level is a low percentage of projects brought to completion and producing substantial economic effect. They are not being adopted as extensively as one would like at the Air Force level and the level of USSR Armed Forces aviation as a whole. At the present time everything possible is being done in order substantially to correct this situation. We have proceeded toward consolidation of efforts in resolving the most acute problems pertaining to volunteer technical innovation by Air Force personnel.

The manpower and resources of industry or Air Force aircraft maintenance depots are being enlisted at the early phases in order to facilitate conditions of adoption and advance preparation of process and design documentation for a significant percentage of such projects. More than 35,000 persons took part in invention and efficiency innovation activities in 1988. More than 30,000 efficiency innovation proposals and 53 inventions have been adopted in a practical manner in the line units. A total of 385 efficiency innovator proposals have been widely adopted at the Air Force level. One notes a higher level of submitted proposals and improved scientific content. Efficiency innovation and invention activity has been well organized in the military units headed by experienced leader personnel A. Batalov, V. Kremlev, K. Chelyshev, Yu. Fuley, V. Tishkov, and V. Babkin. Specific-topic contests for the best technical solutions as well as youth scientific and technical innovation exhibits, organized at the Air Force level, have become a major incentive in the activities of efficiency innovators and inventors. Air Force innovators were awarded 20 Exhibit of Achievements of the Soviet Economy medals, for example, at the NTTM-87 central exhibit, and Air Force exhibits were awarded one gold medal and 28 silver medals at a central exhibit of projects by innovators in the Army and Navy. In May 1988 an exhibit devoted to small-scale mechanization innovations developed in military units and in industry opened at one of our scientific research institutes. An Air Force exhibit on modernization of aircraft equipment, aircraft monitoring, inspection and maintenance equipment was held in February of this year at the same institute. Representatives from industry were invited to visit these exhibits. They have adopted a number of proposals for subsequent implementation. Joint efforts have been organized in many areas. The main conclusion we have drawn is that it is high time to shift from mutual complaints to a serious joint discussion with industry on how to proceed, on how to accomplish better and more rapid adoption.

In conditions of economic accountability and self-financing, this interaction should be optimized to an even greater degree. We can cite several figures as an example. Actual savings achieved from utilization of inventions and efficiency innovation proposals at Air Force economic-accountability enterprises in 1988 exceeded 2 million rubles, which is almost 13 percent more than in the preceding year.

Incidentally, here is another aspect of the new approach to coordination with industrial enterprises. We must state quite frankly that the quality of delivered equipment and arms, monitoring, inspection and maintenance equipment, as well as maintenance documentation at the present time does not fully meet requirements. This makes it considerably more difficult to adopt and use this equipment.

Line-unit aviation engineer service personnel waste hundreds of thousands of man-hours annually on correcting factory defects.

For every type of fixed-wing or rotary-wing aircraft one can list a number of items the poor reliability of which literally drives Air Force personnel up the wall. How do the enterprises respond to this?

It takes years for them to correct some of these problems.

As a new form added to existing organizational and technical measures, party members at the central administrative level of the Air Force Aviation Engineer Service have suggested appealing to the party organizations of the client directorates and industrial enterprises. A group for coordination at the party-organization level on matters pertaining to reliability, flight safety, and combat effectiveness has been formed under the party committee of the Air Force Aviation Engineer Service central administrative staff. Several working meetings have already been held with officials of the party organizations of a number of plants. As initial steps have indicated, this procedure is fairly effective.

[AVIATSIYA I KOSMONAVTIKA] As we know, the Air Force's aircraft maintenance depots are operating under conditions of economic accountability and self-financing. What effect has this had on equipment reliability following overhaul and on depot workforce labor conditions?

[Shishkin] One of the main end results of the radical reform of economic relations is accomplishment of a fundamental turning point in efforts to improve product quality. We realize that in determining directions of restructuring of quality control it is essential to develop a mechanism for creating incentive on the part of individuals and workforces at Air Force aircraft maintenance depots.

A great deal is being done. We have not yet, however, achieved significant positive changes in quality of repair and overhaul, and here is why. First of all the system of collective financial liability for turning out poor-quality product is being adopted slowly at the local level. At the present time the end results of work performed as well as job quality are not sufficiently linked to the wage bonus system.

And yet in conditions of full economic accountability and self-financing, enterprises are able to increase economic incentive funds. The aggregate of organizational and technical measures carried out this year will ensure a decrease in the net cost of commodity output, which calculations show can be used to boost profit by 6.5 million rubles over last year.

An increase in the level of discipline in applying economic penalties for producing poor-quality goods should be reflected in the forming of economic incentive funds not only at the overall enterprise level but also at the level of the shop, brigade, and each economic-accountability unit.

We must skillfully encourage efforts to improve the quality of aircraft overhaul and depot maintenance work. But not everything is satisfactory in this regard. The new conditions of labor remuneration, adopted last year, are not yet being widely applied. In connection with expenditure of a portion of payroll fund and material incentive fund for the purpose of boosting wage rates and salaries at certain enterprises, there has been a decrease in the incentive role of wage bonuses, especially for product quality. Possibilities of lowering job skill category, recertification of specialist personnel, reduction or elimination of additional payment for length of continuous employment in cases of gross violations of process discipline and worsening of labor quality are not being fully utilized.

The level of social development of workforces is exerting considerable influence on matters pertaining to quality and postoverhaul reliability of aircraft equipment. On the whole most of our aircraft maintenance depots possess extensive social services (kindergartens, sanatoria and therapeutic rest facilities, rest and recreation facilities, infirmary-type medical facilities, recreation rooms) and good working conditions.

At the same time, in view of the fact that the main objective of perestroyka is to turn more toward the individual, his needs and concerns, enterprise management, with the extensive participation of the community, is stepping up efforts in this direction. For example, while only 38 percent of capital spending during the current five-year plan was earmarked for building social and cultural services facilities, this figure has been boosted to 60 percent in the plan for this next year.

A housing construction program for the period up to the year 2000 has recently been final-drafted. In order to provide housing to all persons in need of housing, funds to be allocated for building housing in the 13th Five-Year Plan will be double the amount in the 12th Five-Year Plan, while the amount in the 14th Five-Year Plan will be larger by a factor of 2.5.

[AVIATSIYA I KOSMONAVTIKA] Many of our readers are interested in matters pertaining to social protection of aviation engineer service personnel and their job security in conditions of reduction of the Armed Forces and conversion of a portion of military industry to nonmilitary production. What can you tell us in this regard?

[Shishkin] The party's policy aimed at increasing the social directional thrust of economic development plans is in consonance with restructuring in the social domain of Air Force personnel. We must state frankly that study of this aspect of the affairs of military units has made it possible to see phenomena and processes which in the past were not given adequate significance. Lack of attention toward people and the conditions in which they perform their job have made it impossible fully to utilize the human factor and to mobilize it in order to resolve problems of operational readiness, ensuring flight safety, and strengthening military and process discipline. An analysis conducted jointly by us and Air Force scientific research institutes has shown that on a number of points we must proceed at once taking decisive measures.

[AVIATSIYA I KOSMONAVTIKA] What are the most typical deficiencies observed in providing necessary conditions for aviation engineer service operations?

[Shishkin] We are concerned first and foremost by the fact that protective gear currently in service, particularly helmets providing ear protection against aircraft noise and protective suits against electromagnetic emissions, is being used to an extremely inadequate degree. One of the reasons for this is ignorance of requirements pertaining to protection against adverse factors and standards under which failure to use this gear already causes various consequences. At present we lack clear-cut recommendations and conclusions as regards realistic noise and electromagnetic factor levels, and operating and maintenance documentation fails to state requirements pertaining to utilizing protective gear when performing specific operations on aircraft systems. Operational shortcomings of noise-protecting helmets and protective suits, which substantially complicate working conditions (heavy weight, poor ventilation, etc), are another reason why they are insufficiently utilized.

Also requiring resolution is the problem of development, manufacture and delivery to line units of vibration-damping footwear (winter, summer, spring/fall models), highly-effective noise-protection helmets, work-station warming devices (such as tents which envelop and attach to aircraft), easy-to-use protective gloves for fueling and topping off lubricants, and provision of special diet for certain categories of engineer and technician personnel. In the course of servicing aircraft (with a workday duration of up to 12-14 hours), a large percentage of maintenance personnel are exposed to the effects of toxic environments and excessive noise levels, which in many instances exceed the maximum allowable levels by a factor of 10-30.

[AVIATSIYA I KOSMONAVTIKA] Under these conditions, how do unit command personnel and medical services provide protection of the men's health?

[Shishkin] According to the provisions of the appropriate documents, priority in assigning time at sanatoria and rest houses goes to officers, warrant officers and extended-service personnel in health category II, whose jobs involve regular contact with a harmful environment and special working conditions. As a survey in military units indicated, however, about 5 percent of such personnel are provided with stays at sanatoria and rest houses, while approximately 1 percent is provided with stays at unit facilities providing therapeutic rest. There continues to be too little housing available for aviation engineer service personnel. Material incentive for technicians and mechanics to boost their proficiency level are at present being applied only to certain categories of personnel. Available forms of reward for job performance under hard, difficult working conditions are very limited. This is affecting operational readiness, activeness on the part of Air Force personnel and their attitude toward their work. It is not surprising that last year the number of appeals and requests directed to the Air Force central administrative authorities, the Ministry of Defense, and the CPSU Central Committee on housing matters increased by more than double over the the previous year. The total number of letters dealing with discharge of military personnel from active military service, promotion, and transfers has increased by 30 percent. There has been a substantial increase in the number of complaints about shortcomings and deficiencies in provision of goods and services, including medical care.

This indicates that at the local level, in combined units and large strategic formations, command authorities are not always finding correct ways to resolve problems which arise and are not always coming up with persuasive arguments. Sometimes there also occurs inadequate attention to the individual, which is intolerable.

[AVIATSIYA I KOSMONAVTIKA] What practical steps are being taken to improve working conditions for aviation engineer service personnel and to improve moral and material incentive for them?

[Shishkin] In conformity with the CPSU Central Committee and USSR Council of Ministers decree dated 24 February 1987 and pursuant to the requirements of the USSR Minister of Defense order dated 11 May 1987, official regulations on manner and procedure of classification, pay for proficiency rating, and adoption of distinctive chest badges went into effect, for the purpose of further increasing the flying proficiency and knowledge of theory on the part of officers with the position of engineer or technician and serving as member of the aircrew of a fixed-wing or rotary-wing aircraft, and to improve their skill and proficiency for the performance of combat missions.

Proposals pertaining to manner and procedure of classifying engineer-technician personnel involved in aircraft servicing and maintenance and determination of pay for proficiency rating have been submitted to the USSR Ministry of Defense this year for consideration.

A plan of measures to provide suitable working conditions for engineer-technician personnel in aircraft servicing and maintenance, based on the results of a study

of working conditions of engineer-technician personnel, has been drawn up and approved by the Commander in Chief of the Air Force. It prescribes a number of effective measures: in particular, development of new specialized work clothing and footwear as well as protective gear against noise and vibration, for engineers, technicians, and mechanics; vitamin supplementation to the diets of certain categories of specialist personnel; improvement of means of small-scale mechanization; provision of special personnel rest facilities at TsZT [expansion unknown] and on aircraft flightlines; shortening of the prescribed service life of existing specialized work clothing; plus many other items.

We are attaching considerable importance to implementation of the principle of social justice. For example, when considering officer candidacies for job promotion and additional training, selection is made on an alternative basis with substantive and to-the-point discussion at an officers' meeting and in the primary party (Komsomol) organization. In our opinion group discussion of candidacies makes it possible most correctly to utilize the above-listed forms as an indoctrinational factor. We are adopting this practice at all levels of aviation engineer service control and management.

In conditions of implementation of organizational measures to reduce air forces within the USSR Armed Forces in 1989-1990, one very important issue is redistribution of aviation engineer service officers among large strategic formations which are short of personnel in certain categories, adjustment in the size of graduating classes at Air Force secondary technical and higher engineering schools, individual examination of cases involving discharge into the reserves of persons who have served the required number of years, as well as aviation engineer service specialist personnel who have requested early discharge from the military. You can understand that this requires consideration of all factors and opinions, special attention, and sensitivity toward individuals.

The USSR Congress of People's Deputies and its first session provide us with a good example in this regard. Further democratization of life and affairs in Air Force units, development of forms of debate, discussion, and dialogue, and consideration of the opinion of each individual airman, alongside strengthening respect for orders, one-man command, and a high degree of military professionalism, should provide a guarantee of the social and legal protection of military personnel and the members of their families. I believe that resolution of these and other issues will help maintain the combat readiness of Air Force units and subunits at an adequate level and will help ensure effectiveness and quality of flight activities.

Medical Aspects of Military Flying Discussed

90R10007B Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 10, Oct 89 (signed to press 12 Sep 89) pp 4-5

[Article, published under the heading "For a High Degree of Combat Readiness," by Lt Col Med Serv A. Medenkov, candidate of psychological sciences: "How Can We Help You, Pilot?"]

[Text] Today the flight surgeon more than anybody else can and should help pilots rationally and efficiently utilize their system's psychophysiological reserves, ensure reliable pilot work performance, and diminish the effect of adverse factors. Thorough knowledge and skilled daily utilization of the recommendations of aviation medicine and psychology constitute a guarantee of successful work performance by the flight surgeon.

But knowledge constitutes only initial capital, to which one must constantly add. Equipment is becoming increasingly more complex, psychological and emotional stresses are increasing, and the effect of adverse factors of flight is intensifying. Therefore, means of protection and methods of forming and maintaining flying fitness must become more effective. Scientists specializing in the field of aviation medicine and psychology are setting for themselves precisely this task.

The flight surgeon also must keep current on all new developments. How can this be accomplished?

Conferences are regularly held for ranking medical service officers, at which the state of affairs is analyzed and paramount tasks pertaining to medical support of flight operations are refined and detailed. Scientists present reports at these conferences on results of research being conducted. This is followed by an exchange of views. Practical problems which should be subjected to experimental study as well as the needs of medical personnel in the area of specialized literature are determined in the course of discussion and debate.

I believe that such discussion could be more effective if it involved all flight surgeons, as well as flight personnel, even if it did not mean actual physical attendance, for what are being discussed are possibilities of and capabilities to maintain the physical and mental health of flight personnel. For this reason we should resolve once and for all the matter of prompt publication of conference proceedings and synthesis of the comments and suggestions of flight surgeons.

But can specialist personnel help flight personnel only via the flight surgeon? Of course not. Many recommendations are addressed directly to the pilot. There is no doubt about the fact that these recommendations are needed. For example, flight personnel are learning to fly new equipment. How can the required skills be better and more rapidly acquired? An answer to this question can be found in the specialized volumes "Psikhologicheskiye voprosy letnogo truda" [Psychological Aspects

of Flying Labor], "Problemy osvoyeniya novoy aviatsionnoy tekhniki" [Problems of Mastering a New Aircraft], and "Psikhologicheskiye osobennosti poleta pri nizkom minimume pogody" [Psychological Features of Flying at Low Weather Minimums]. The authors of this latter volume, for example, show that not only an aircraft's aerodynamic characteristics and the technical capabilities of airborne and ground equipment help when flying a landing approach in instrument meteorological conditions, but the pilot's psychological preparation as well.

A memorandum entitled "Preventing Fatigue and Flight Personnel Mental Health" is directly addressed to flight personnel. Fatigue naturally develops in the process of any activity, but it can also set in prematurely. What is the reason for this? The fact is that fatigue is caused not only by work load on the system but also by high neuroemotional stresses, inadequate proficiency and physical conditioning, by complexity of the flight assignment, by poor level of motivation, protracted waiting for departure, lack of rest facilities at the airfield, as well as other factors.

Diminished work efficiency and job reliability sometimes leads to undesirable consequences. This situation cannot be tolerated. Commanders and flight surgeons bear responsibility for this. But what about the pilot himself? He too should be interested in a correct assessment of his state and condition, since in many cases he may be the first to notice symptoms of functional unpreparedness to perform assigned tasks. The purpose of the training manual "Voprosy psikhofiziologicheskoy podgotovki letnogo sostava" [Aspects of Psychophysiological Training of Flight Personnel] pursues the aim of teaching this to the pilot, as well as demonstrating the possibilities of pilot successful performance in a difficult situation.

Many pilot errors are a consequence of deficiencies in equipment design. Ergonomic requirements are not always adequately considered when designing aircraft and aircraft equipment. It therefore becomes necessary to draw the pilot's attention to the inconvenient placement of instruments and controls, poor cockpit lighting, and limited cockpit visibility. For this reason special volumes are being prepared, dealing with ergonomic problems of optimizing the activities of operators of airborne and ground systems. In particular, the textbook "Psikhologicheskiye osobennosti osvoyeniya poletov s ispolzovaniyem sistem avtomaticheskogo upravleniya" [Psychological Features of Learning to Fly Using Automatic Control Systems] proposes an attention distribution sequence which guarantees correct pilot actions in a specific situation.

Analysis of in-flight mishap-threatening incidents is a special area of activity for specialists in aviation medicine. And the purpose is not to point out the guilty party but to determine the cause, involving inadequate consideration of the pilot's psychophysiological characteristics, and a cause which could reappear when others get into a similar situation.

What should be done to ensure that recommendations are more fully taken into consideration by pilots? Unquestionably a great deal depends on the textbooks' authors. It would be desirable for the suggestions and advice presented by scientists and specialists in aviation medicine and psychology to be briefer, practically realistic, and be presented in understandable terms, without excessive scientific jargon. This is not easy to accomplish, but it is entirely possible. Articles and studies written by V. Ponomarenko, V. Kozlov, and V. Varfolomeyev can serve as an example.

Nevertheless this is not the principal way to increase the effectiveness of the recommendations of aviation medicine. The principal reserve potential lies elsewhere. When scheduling preflight preparation one must specify the area and study topics in which specific textbooks, brochures, and instruction booklets should be used.

Should pilots not have knowledge of the psychophysiological peculiarities of landing approach procedures and actions when performing expert-level advanced aerobatic maneuvers? Of course they should. For this reason a series of lectures on aviation psychology has been prepared to assist them. The films "One-on-One With the Desert," "In the Taiga During Winter," "On the Open Sea," "In the Arctic," and others can prove useful when studying topics pertaining to emergency ejection and survival. Pilots suggested the subject matter of these films, and specialists in the field of aviation medicine put together the sequences.

A film-aided course entitled "Psychology of Flying Labor" has been prepared. The films "Spatial Orientation" and "Overcoming Obstacles" are currently available. "Preparedness for Danger" will soon be available. Films entitled "Pilot Psychological Training" and "The Flight Simulator: The Way to Gain Flying Skills" are presently being made.

In addition to literature and films, special posters are produced for pilots: "Diagnosing Fatigue (Excessive Fatigue) in Flight Personnel," "Making Long Flights," "Preventing Overheating in Hot-Climate Regions," and "Preventing the Adverse Effects of Light." Earlier-issued series include "Pilot High-Altitude Gear," "Safety Procedures When Ejecting," etc.

Literature, films, and posters cannot take the place of the living word, however. For this reason lectures, discussions, and practical training classes continue to remain in the scientist's arsenal. But are these measures sufficient? Why are the possibilities of radio, television, and military district newspapers poorly utilized? In all fairness we must note that presentations by representatives of space medicine and psychology directed toward protecting the pilot have begun appearing on radio and television, but very rarely. That is a pity, for matters

pertaining to length of flying career and social protection of military flight personnel are becoming very important, and it is very difficult to resolve these problems without the help and attention of the public.

What else is important? It is important to create a "hotline" between pilot, flight surgeon, and scientist. Then the concerns and problems of flight personnel will become the latter's common concerns as well. A goal is reached sooner when people walk toward it not from different directions but hand in hand. If this is done, it will not be necessary to raise the question stated in the title of this article. The pilot and flight surgeon will simply stride together toward flight safety, a high degree of operational readiness, and a long flying career.

Unit Party Committee Sheds Old Ways

90R10007C Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 10, Oct 89 (signed to press 12 Sep 89) pp 6-7

[Article, published under the heading "Party Affairs: Progress With Perestroyka," by Lt Col I. Ryzhenkov: "Right of Way"]

[Text] While flying a training sortie a young pilot reported that he had lost contact with his element leader. He was given instructions on how to proceed, which he carried out precisely.

The flight ended without incident. Nevertheless the experience was very hard on this officer. He was tortured both by professional embarrassment and anticipation of punishment.

At the flight operations critique and analysis session this pilot did not get a single insulting remark, nor was he berated. On the contrary, after analyzing his mistake, the regimental commander noted the correctness of his subsequent actions. After all, instead of giving a truthful report this officer could have started looking for his element leader, which could have resulted in a serious mishap-threatening incident.

This incident occurred quite some time ago. But an atmosphere of openness, honesty, and at the same time party-minded firmness has taken rather firm root in our unit. This is fostered both by the unit command element and the party committee. A survey of flight personnel was taken at our initiative, for example. We heard the following response to the question: "what are the reasons for concealing mishap-threatening incidents?" Frequently analysis of the causes of a near-mishap incident is performed in a lip-service manner, with failure to determine the root causes; sometimes the pilot is accused of every imaginable sin; harshness of punishment for a near-mishap incident prevails.

This gave us plenty of food for thought.

Indeed, a system has formed over the course of many years whereby party committee members have frequently functioned as criminal investigators, investigators of particularly unsavory crimes, one might say. And the educational and indoctrinational functions of the party committee gradually began more and more frequently boiling down to punitive functions. They did not at all contribute, however, toward strengthening the vanguard role of party members in improving combat readiness and strengthening flight safety and military discipline. Guarded watchfulness, lack of communicativeness, and a certain apathy were sensed in the unit.

At the same time the CPSU Central Committee was persistently pushing the idea of a radical restructuring of party work, and the mass media were reporting results. All these things—the influence of the new and the impossibility of continuing in the old way—forced us in large measure to appraise our activities in a critical manner.

And it was finally decided at a party committee meeting to scrap the old way of doing things. What was it to be replaced with? Trust, glasnost, and instilling of excellent moral qualities in flight personnel, plus attentiveness and skilled assistance in place of a lip-service approach. The main thing was to raise the vanguard role of CPSU members in a practical way.

Our course of action was not really so extraordinary. We simply endeavored to make a sober assessment: what must be done to move things forward, and what is hindering progress? We moved to the forefront not an effort merely to make accountability reports sound good but rather a campaign to achieve genuinely excellent end results of flying labor, not noisy beratings, but rather thorough analysis of a given incident, particularly an in-flight emergency or air mishap. Performance analysis data and the causes of given mistakes and errors became for the party committee not a bill of indictment but rather a subject for detailed, thorough work with individuals.

As already stated, this position was taken first and foremost by the regimental commander—a party committee member. He and his deputies began devoting more attention to prevention of mishap-threatening situations and began seeking to determine their causes. For example, while checking organization of night flight operations in one of the squadrons, party member N. Berezhilenko noticed that solo night flights had been scheduled for pilots who had not been up for some time, constituting a violation of proper training methods. Potential adverse consequences were averted. The party committee took a closer look at the activities of the methods council, took steps to intensify and improve its activities, and began to follow the practice of having council members regularly submit reports to the party committee and at meetings. The party bureau stepped up

its monitoring of the quality of scheduled training activities, preliminary and preflight preparation of flight personnel, and analysis of flight operations in the subunits.

Once we encountered instances where certain leader-Communists were showing a poorer personal example in preparing for training sorties. In the past we might have merely shaken our head reproachfully, in order not to diminish commanders' authority in the eyes of their subordinates. But both the regimental command element and the party committee were in agreement on this point: imposing greater demands on the leader-Communist does not affirm his right to privilege, but on the contrary it means increased responsibility and increased demands. They stated the matter precisely in this manner in the party committee, and they publicized elements of negligence and irresponsibility on the part of guilty parties. I must say that this had quite an effect on command personnel and forced many individuals to get their act together.

Continuing this policy, we heard reports by leader-Communists at open party meetings. Party member V. Tupitsyn, for example, told about his personal contribution toward achieving flight safety and improvement in flight training. Party member G. Yakhyayev reported on his role in improving aviation engineer service control and management and in maintenance personnel increasing their technical knowledge. Many questions were put to leader personnel in the course of these frank discussions, and sharp critical remarks were directed at them. It was evident from all indications that people's indifference toward party affairs was a thing of the past and that a feeling of involvement in the state of affairs in the unit was being developed on the part of Communists, Komsomol members, and the party-unaffiliated.

These meetings gave a powerful impetus to openness and sincerity in interpersonal relations, and of course also sharply increased the responsibility of party members for their lofty title. The majority of CPSU members gained a new awareness that henceforth their activities, their every step, will be assessed by the collective openly and according to the highest criteria.

The party committee is endeavoring to support and further to develop these feelings. We are placing emphasis on work with individuals. Many examples could be cited. I do not believe, however, that this is the point, but rather the fact that we are getting together with people not just for the sake of form or just another pep talk. The main task is to establish genuine contact, to earn trust, and to strengthen a unity of views on matters both purely specialized and pertaining to ethics and morality, as well as raising personal responsibility and commitment for accomplishing assigned tasks.

Preliminary results in combat and political training indicate that the majority of CPSU members have a correct understanding of their vanguard role and display personal exemplariness in performance of job duties. In particular, during the entire period of training party members displayed tireless attention toward matters pertaining to training, political instruction, strengthening discipline, and the moral atmosphere in the unit.

For example, talks with pilots have been held and continue to be held on a regular basis at the initiative of the party committee, at which there is an exchange of experience and know-how, with detailed discussion of advanced teaching methods, typical mistakes in flying techniques, and ways to correct them. Every military aviator has the opportunity not only openly to express his opinion on these matters but also to make suggestions and proposals, on which decisions are made. For example, a method of preparing a theoretical model of combat with the potential adversary has become a regular part of practical training, based on a suggestion made by pilots, and "one-on-one situations" are simulated, especially by alert-duty pilots.

In our opinion a recent tactical air exercise involving interception of a "threat" aircraft went well. Party members Ye. Kretov, V. Luka, and V. Serdyuk did an excellent job.

It has long since been noted that if people see that their endeavor to improve things in the unit is supported by their commanders, superiors, and party activists, they gradually take a positive experiential posture. We are presently observing this process in our own unit. It may not proceed totally smoothly, and perhaps not all problems have been solved, but there is no other path to follow but perestroyka.

Readers' Legal Questions Answered

90R10007D Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 10, Oct 89 (signed to press 12 Sep 89) p 7

[Article by Col Gen S. Kuznetsov: "Legal Consultation"]

[Text] **Certain problems pertaining to labor laws as well as various legal aspects of military service and off-duty life are of interest to Air Force personnel and the members of their families. Col Justice S. Kuznetsov replies to a number of such questions.**

* * *

[Capt S. Kolosov] Under what conditions do the spouses of military personnel retain their unbroken record of employment when the husband is transferred to a new duty station?

[Reply] Transfers of military personnel involve relocating to other localities or military units, which as a rule requires that family members also change employment. One can understand their concern about retaining their record of uninterrupted employment, since in most cases this is what determines size of benefits, pensions, etc.

The rules and procedures of calculating length of continuous employment were ratified by decree of the USSR Council of Ministers dated 13 April 1973 and were stated in a USSR Minister of Defense order.

Pursuant to these rules and procedures, credit for continuous term of employment, of a spouse, for example, is retained regardless of length of interruption in employment in connection with her husband's transfer to another garrison. The following entry shall be made in her employment record book: "Terminated at the employee's request in connection with her spouse's transfer to employment in another locality. Article 31, RSFSR Labor Code."

If a member of the military is transferred to another unit within the same locality, a move by his spouse to other employment has nothing to do with his transfer, and record of continuous employment is retained if the period between employment does not exceed three weeks.

When a member of the military is assigned abroad, the time spent abroad by the members of his family does not count toward total time of employment, but record of continuous employment is retained if the time between the date of return to the USSR and the date of commencement of employment does not exceed two months.

[Lt Col A. Omelchuk] How is term of continuous employment calculated for a member of the military who has been discharged into the reserves or has retired?

[Answer] Service in the USSR Armed Forces and in the organizations of the USSR Committee for State Security and USSR Ministry of Internal Affairs counts toward record of continuous employment if the time interval between the date of leaving the service and the date of commencement of employment does not exceed three months. For female military personnel discharge from the USSR Armed Forces and organizations of the USSR Committee for State Security in connection with pregnancy or childbirth, total length of service as well as periods during which they were paid pregnancy and childbirth benefits and child care benefits shall be included as part of term of continuous employment under the condition that said individual commenced employment or study before the child reached the age of one and a half years.

[Col (Res) N. Tolkunov] I have heard that working pensioners are entitled to two months leave at a time of their choice. What conditions must be met to qualify for such unpaid vacation?

[Answer] It is true that pursuant to Decree No 674 of the USSR Council of Ministers, dated 14 September 1973, working old-age pensioners and disabled individuals of disability categories I and II may be given, at their request, up to two months unpaid leave from their employment. One must bear in mind, however, that this privilege is available to pensioners and disabled persons working at enterprises and in areas designated to employ the labor of these persons.

In addition, Decree No 850 of the CPSU Central Committee and USSR Council of Ministers, dated 11 September 1979, authorizes management of enterprises and organizations in the material production domain and service industry to grant up to two months unpaid leave to old-age pensioners, at their request, with the agreement of the trade union committees.

Proper Radio Communications Procedures and Flight Safety

90R10007E Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 10, Oct 89 (signed to press 12 Sep 89) pp 8-9

[Article, published under the heading "Flight Safety and the Human Factor," by Sr Lt Med Serv O. Rybnikov: "What Was Said Over the Radio...."]

[Text] **Sr Lt Med Serv O. Rybnikov shares his thoughts on the role of the human factor in tactical control**

* * *

The pilot successfully accomplished the mission.... Credit for this goes to all specialist personnel who took part in organizing and carrying out the sortie, but nevertheless special credit goes to the tactical control officer (TCO), for it is his experience and skill which in large measure determine accuracy and timeliness of attack, and he is the one they turn to when in-flight emergencies occur.

...The elegant Su-27 aircraft gracefully lifted off and climbed skyward. The two-ship element had been scrambled to intercept a "threat" aircraft. Work was in full swing at the command post. The GCI controller was making preliminary calculations: he was determining mission phase points, points at which to light the afterburners, optimal flight path, as well as other parameters.

Accuracy, speed and efficiency of performing calculations are directly determined by the specialist's personal qualities, for he must perform a number of operations mentally, in conditions of a large volume of incoming information. This results in a situation in which a tactical control officer is operating at the limits of his psychophysiological capabilities. Employment of computer hardware, including programmable electronic calculators, is one way to increase the reliability of his work performance. This would be desirable, but in the meantime....

The local controller hands the fighters off to the tactical control officer. He will soon be called upon to bring to bear his entire knowledge of the aircraft and air tactics. The scrambled fighters have reached the point of engagement, but the "threat" aircraft has skillfully employed

fighter-evasion maneuver. Long-range engagement was now out of the question. They would now be engaging in close-in air-to-air combat.

The aircraft radar returns on the PPI display had not yet merged. The GCI controller was actively controlling the interceptors, informing them of the "threat's" course, altitude, and nature of maneuver. Finally the blips merged, but the pilots were not recording engagement. The GCI controller began to get nervous. Sometimes his nervousness is passed on to the pilot. This is why it is essential to bear in mind at all times that he is working with living, breathing individuals. For this reason he must closely monitor what he says into the microphone.

Voice communications always carry redundant information and reflect the emotional state of the speaker. Pilots who work for an extended period of time with the same GCI controller are able to assess the situation on the basis of intonation. If his voice is confident, everything is proceeding well. If his voice sounds irritated, this means that controller instructions have not been executed correctly. The tactical control officer bears particular responsibility for the tone of radio communications. At critical moments his calm, even voice and precise instructions help pilots maintain composure and help them successfully extricate themselves from their present situation.

Speech is the most significant of all signals, and a person is inclined to place full credence in a spoken message, especially in a stress environment. The number of queries and instructions should be kept to a minimum. All extraneous talk should be eliminated, and the rules and procedures of radio communication should be observed to the letter.

There are a great many examples of the consequences to which failure to observe these rules can lead. Here is one example. A pilot was instructed by the local controller to proceed to an altitude of 450 meters and switch to the regimental command post frequency, but he failed to confirm. And since he had heard the instructions incorrectly, he proceeded to an altitude of 4,050 meters. It was only intervention by the flight operations officer which prevented the occurrence of a hazardous situation.

Voice communications are continuously monitored by one's consciousness. There is no automatism here. For this reason it is difficult to acquire skills in information exchange with the aid of standard phraseology, but on the other hand such habits readily break down.

In one's everyday life a person makes extensive use of synonyms and is able to substitute one word for another which is close in meaning, and one uses variable phraseology. It is in large measure due to this that speech becomes fairly rapid and smooth. The commands and instructions issued by a tactical control officer are of rigidly-prescribed form both in composition and phrasing. It is these differences between daily speech habits and speech in a control environment that explain the occurrence of misunderstandings.

It still frequently occurs that mishap-threatening in-flight situations arise as a result of breakdown of interaction between pilot and ground control. For example, while flying a practice intercept in instrument meteorological conditions, a pilot responded to instructions intended for another aircraft. The intercept failed.

Here is another example. An experienced transition-area controller, while passing off an aircraft to the terminal-area controller, mixed up the aircraft's callsign. This error led to a potential collision situation in the vicinity of the airfield, and it was only prompt actions by the flight operations officer that prevented a collision from occurring.

These seemingly similar incidents contain a common internal pattern. This pattern consists of the psychological peculiarities of perception and storage of information encoded in verbal form. An important role here is played by rhythmic pattern of communications. The process of speech recognition contains as an intermediate element the forming of an articulated image of an auditorily-perceived element. Only after this does semantic identification of a command ensue. This is why messages containing the same number of syllables and the same distribution of stresses are confused with one another with the greatest frequency. This explains the mishearing of pilot callsigns or misidentification of instructions intended for another aircraft. The fact is that aircraft callsigns are spoken in a very similar rhythm.

A tactical control officer works in conditions involving factors which frequently cause a state of stress. The latter leads to considerable changes in one's speech. These include speaking more loudly, change in the spectral composition of sounds, drawing out of phrases, and the occurrence of pauses and parasite words. In rare instances speech breaks down entirely: the transmitted information loses its specific sequence and sense.

Two helicopters were flying a weapons-delivery sortie. Following bomb delivery at the range, the aircraft approached dangerously close to one another. The situation was correctable, but the following command was given: "Left ship, turn right." The incident ended in tragedy.... This is a typical example of stress breakdown of speech generation program, which confirms that speech is highly subject to various adverse influences.

In order for such things not to occur, it is necessary to solve many problems of the tactical control officer. This applies first and foremost to organization not only of their job training but also to receiving adequate rest. At the present time, however, one fairly frequently observes something like the following. An air-to-air combat training sortie was completed. The aircraft returned to their home field. The command post team gathered in the smoking lounge, for there was no other rest facility available. The rooms designated for this purpose are as a rule used for all kinds of other purposes. They are used as storerooms, classrooms, and mess facilities.

And where such facilities are actually available, can one actually get any rest in them? And yet rest—psychological relaxation both during and after a duty shift—is absolutely essential! A high level of stress and tension, protracted concentration of attention, a darkened room, and periods of monotonous actions rapidly cause a state of discomfort, subsequently lead to fatigue, and adversely affect reliability of job performance. While economizing on concern for personnel, we pay the price of diminished combat readiness and flight safety. It is high time to comprehend this fact.

Unfortunately possibilities of full-value rest at therapeutic rest facilities for tactical control officers are not always used. And yet this group of Air Force specialist personnel requires constant attention by medical personnel. The most effective rehabilitative measures should be taken when they begin to show symptoms of tiredness and excessive fatigue. A job-adequate state of health and a high level of work fitness on the part of tactical control officers are important components of flight safety.

Experimental Learning Method at Air Force School

90R10007F Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 10, Oct 89 (signed to press 12 Sep 89) pp 10-11

[Article, published under the heading "Educator-Innovator's Rostrum," by Maj G. Ryabkov, senior instructor, Kaliningrad Military Aviation Technical School: "The Shchetinin Method"]

[Text] The problems of our military education system are well known. They include dogmaticalness of curriculum, predominance of passive methods of learning, duplication of material, poor quality of course literature, excessive work loading of students and instructors, and inadequate school facilities.

The very method of instruction contains shortcomings, with a personal, individual approach to students and instructors lacking, and with failure to take into consideration their psychological state. It is no secret that the majority of students are in a state of tension when a class begins, tension caused by fear of being called on by the instructor. The instructor, however, is as a rule calm at this time. The roles switch when presentation of new material commences: the instructor's attention and effort is concentrated, while the students are relaxed for a period of 10 to 15 minutes. As a result the most important initial phase of a class is utilized unproductively.

The traditional method is oriented toward the average student and, as a consequence, it reduces all students to a common level. He who is able to proceed more rapidly on a subject is deprived of such an opportunity and frequently loses interest in his studies. Students with a poor level of knowledge fail to assimilate a substantial portion of the material, constantly experience discomfort in class, and they are either dismissed for lack of desire to study or they are graduated as inadequately-trained specialist personnel.

One is concerned and troubled by excessive fractionalization of the course material. In some subjects there are as many as 15 or more topics. Over the course of many years the opinion has been formed that the more finely material is divided up, the easier it is to assimilate. This results in disruption of an integral perception of the subject. We are faced with a situation similar to that where a person who is seated too close to the television screen sees only the dots and scanning lines but fails to see the picture as a whole.

One substantial shortcoming consists in the fact that the traditional process of learning, including examinations, is directed toward reproductive cognition, toward testing memory, and fails to cultivate creative elements.

The method devised by educator-innovator M. Shchetinin is based on the idea of evolving instruction. In order to correct the deficiencies noted above, he proposes presenting course material not in tiny doses but rather in large blocks, by means of so-called "immersions." The structure of studying a subject using the Shchetinin method is as follows.

First "immersion"—introduction to the subject, forming of an interest in it and a goal-directed mindset—"I need this!" Over a period of from five to seven days (four hours each day), the basic points and concepts are presented, given at the descriptive level, and terminology is worked on.

The second "immersion" begins following an interval of one to one and a half months (figuring on the effect of long-term memory as the most solid memory). It includes explanatory material. Purpose: theoretical substantiation of the subject: deriving formulas, detailing graphs and diagrams, and communication of a system of concepts. Duration—six to seven days.

The third "immersion" takes place one month after completion of the second. In the course of this sequence theory is reproduced at a new level: in writing and orally, with the extensive use of visual aids. In other words, it is devoted to testing and reinforcing knowledge. Duration: six to seven days.

The fourth "immersion" is of a purely creative nature. The students work on formulating and solving problems and acquire skills. As a rule classes are conducted by groups.

Thus a subject is taught not sequentially, by topics, but in parallel, proceeding from a low level of cognition to a higher level, from a general understanding to assimilation of the tiniest details.

Since last year an experiment has been in progress at the Kaliningrad Military Aviation Technical School. The

Shchetinin method has been certified for electronics-related subjects: first semester—Electronics; second semester—Electronics, Computer Fundamentals, and Aviation Radio Transmitters. We considered it necessary, however, to omit an "immersion" devoted to testing knowledge, while we conclude each of the three remaining "immersions" with a graded test. In all other respects the structure is maintained.

The first "immersion"—a block of lectures—runs from five to six days, four hours each day. In the third pair of classes on these days, students work on drill, weapon training, physical training, tactics, history of the CPSU, etc. The second "immersion" block of lessons is the principal one. Depending on the volume of subject materials, it runs from 10 to 19 days. It is subdivided into subblocks of five to six days each. The third "immersion" constitutes a block of group and laboratory classes, so-called practical training. Its principal objective is to develop skills in problem solving and performing research on laboratory equipment. This also runs from five to six days, four hours each day.

Two- and three-minute breaks every 10-15 minutes during the course of a class and a five-minute physical training break after 45 minutes ensure a decreased tendency of students to become fatigued. This routine makes it possible to conduct classes at a rapid tempo. Soft, continuous symphonic music promotes student psychological comfort and mental concentration.

We have adopted an incentive system in place of marks in order to make students feel less stress when questioned or quizzed by the instructor and in order to make students more active in class. The incentive system makes it possible to differentiate the learning process and establishes a lower and upper activeness threshold. When a student earns total points exceeding the upper threshold, he automatically receives test credit. If the point total fails to reach the lower threshold, however, the student's knowledge must be thoroughly tested, for the end result is determined according to an "activeness plus effectiveness" system. In other words, each student is graded by his activeness in class and quality of answers when quizzed.

The experiment has been in progress for one year now. It is therefore still too early to reach final conclusions, but one can state certain intermediate results. One student replied as follows to a survey question "How do you feel about the experiment?": "For the first time in my life I felt that my doing well in my studies is of interest not only to me but also to my comrades and my instructors." One hundred and twenty-seven out of 130 persons polled in the second semester were in favor of the experiment. This indicates that they have a high emotional commitment toward and interest in their studies. There was not one single case of a student coming to class unprepared for a non-valid reason.

One hundred and eighteen students voiced approval of the incentive grading system. The majority stated that it makes them more relaxed, eliminates fear of being quizzed and stimulates activity. All persons visiting and inspecting classes noted that the students displayed activeness and were prepared to give answers to fairly complicated questions.

We noted a trend toward an increase in the number of students who fairly rapidly received marks automatically. After this they would be exempted from attending class and would continue studying the subject, ahead of the class pace, and on their own. During this time they assimilated a much larger volume of materials, together with the other students, and with good quality, which was confirmed by a testing of their knowledge. At the same time the number of passive students steadily declined.

Table

Number of Class Section	Subject			Average Point Grade for Session
	Electronics	Computer Fundamentals	Aviation Radio Transmitters	
13	3.65	3.7	3.7	3.68
14	3.6	3.6	3.02	3.41
15*	3.75	3.86	3.7	3.77
16*	3.55	4.07	3.44	3.69
21*	3.76	3.44	3.68	3.63
22	3.3	3.36	3.4	3.35
31*	3.2	3.4	3.0	3.2
32	3.5	4.0	3.4	3.63
41*	4,03	3.92	3.6	3.85
42	3.5	3.58	3.64	3.57

* Participation in experiment

Summer session results are promising (see Table). The five class sections which took part in the experiment produced course examination grades averaging 3.63, while the other class sections averaged 3.53. In the new school year the experiment is continuing with these sections, as well as with three additional sections, covering the following subjects: third semester—Aviation radio receivers and Electronic Systems; fourth semester—Circuit measurements and Electronic equipment design. Twelve class sections in the first year of study are now taking part in the experiment, in three subjects: Electronics, Electronic instruments, and Electrical engineering.

Extensive adoption of the Shchetinin method requires changes in organization of the instructional process. We see these changes as the following:

—to determine in each subject the minimum volume of knowledge required to assimilate. One should eliminate duplication and presentation of secondary material, in return allocating 15-20 percent of class time to student independent study of the appropriate literature, under the supervision and guidance of instructors;

–prior to the beginning of each semester, all students should be given lists of questions, so that they can prepare in advance, take and pass tests ahead of schedule;

—the session as such should be eliminated, with examination given when study of the class material has been completed;

—monthly grading should be discontinued, using only an incentive and encouragement system;

—length of classes should be reduced from 90 to 75 minutes (35 minutes x 2 + 5 minutes physical exercise pause). The freed-up time should be made available to instructors for working with students;

—technical school students receiving top grades should be given the opportunity, following one year of study, to take a personal interview for acceptance at higher engineering schools. If the interview is successful, they should be transferred to the engineering school as a first-year student without being required to take entrance examinations.

Assimilation of the curricular material is essential, and this is the main thing. The end objective is not only mastery of the subject but also development of speaking ability, thought process, interests and capabilities, and the forming of moral-ethical qualities and convictions. This can be achieved only with the aid of developmental learning. K. Ushinskiy once wrote: "One must remember that it is necessary to transmit to a pupil not only certain knowledge but also to develop in that pupil the desire and ability to acquire new knowledge independently, without a teacher." We view precisely this as our principal task.

Air Force Propaganda Chief Appeals For More Perestroyka Efforts

90R10007G Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 10, Oct 89 (signed to press 12 Sep 89) pp 14-15

[Article, published under the heading "Implementing the Decisions of the 19th All-Union CPSU Conference," by Maj Gen Avn V. Makeyev, chief, Propaganda and Agitation Department, deputy chief, Air Force Political Directorate: "New Thinking—Call of the Times"]

[Text] Perestroyka in the Air Force, as in the USSR Armed Forces as a whole, requires people with a new view of the phenomena and processes taking place in this country and in the world, with new political thinking, and with a high degree of legal and ethical awareness. Forming of these qualities in military cadres is an imperative demand of the times. Figuratively speaking, however, nobody is going to give us such individuals in ready form. We ourselves form and shape their consciousness and thinking: departments at military aviation schools and service academies, command and political personnel, ideological, party, and Komsomol activists in the units and combined units.

How is this process proceeding? Study of this question at a number of military aviation schools, in line units, and at the Air Force Engineering Academy imeni N. Ye. Zhukovskiy enables us to perform an analysis, reach conclusions, and draft specific recommendations. For example, acquaintance with the activities of the department of Marxism-Leninism at the Saratov Higher Military Aviation School for Pilots (department chairman Lt Col P. Sadovoy), involving developing in the cadets new military-political thinking, new political and moral-ethical awareness, has shown that on the whole the department is performing the task and is among those components which are conducting active restructuring of the teaching process taking into account the demands of the time.

In conformity with the program of restructuring, annual and monthly plan targets, the department is devoting considerable attention to methodological, scientific research and instructional activities. A good impression is made by department research efforts aimed at raising the ideological-theoretical and methodological level of teaching the social sciences and strengthening the link between curricular instruction and practical needs.

Emphasis in class instruction is being placed on adoption of active forms of activity: individual discussions, independent work under instructor guidance, etc.

Subject-methods panels are working productively. They have put together and added to a topical plan on history of the CPSU. They have incorporated into it problems considered "blank spots" in our history. The dialogue method is used in presenting lectures, and instructive materials have been prepared on each course topic. Subject-method panel members officers V. Murugov and N. Ignatyev have focused plan-schedules for practical classes on party political work toward the specifics of flying activity and matters pertaining to flight safety. Methods for conducting seminar classes with elements of political aggressiveness, purposeful games, and mutual student question-and-answer activities have been drawn up and adopted. During these classes cadets play the role of flight and squadron commanders, secretaries of party and Komsomol organizations, practice skills in conduct of individual discussions, etc. Officer-political workers and instructors N. Bezborodov, V. Murugov, B. Sadovoy, A. Kuznetsov, P. Belichenko, and others give generously of their experience and knowledge.

During our visit at the school we conducted a small sociological study involving a survey of fourth-year cadets, who can be considered, so to speak, to be the "finished product" of the department's efforts. We asked them to assess the department's performance and the results of its efforts to equip cadets with theory and methodology of perestroyka in the Air Force, efforts to form and shape a new historical consciousness, military-political thinking, and new political, legal, and moral-ethical awareness. Two thirds of those surveyed gave a positive assessment.

It would be incorrect, however, to see everything as perfectly fine. There are problems, and substantial ones at that. Incidentally, the cadets also mention these problems. For example, many of those surveyed are dissatisfied with the quality of study at the school of the last articles and letters written by V. I. Lenin and with the level of legal knowledgeability and organization of universal basic education in the law.

Although the Saratov Higher Military Aviation School for Pilots has had fairly substantial positive results in developing the new military-political thinking in cadets as well as a new political, legal, and moral-ethical awareness, we should like to focus attention on shortcomings in this area. They are also typical of political agencies and departments of Marxism-Leninism at other Air Force schools, in particular the Kiev Higher Military Aviation Engineering School, the Air Force Engineering Academy imeni N. Ye. Zhukovskiy, as well as of political agencies, party committees and bureaus in a number of Air Force line units.

At the Kiev Higher Military Aviation Engineering School, for example, many of the cadets and officers surveyed have only a very superficial notion of the concept and methodology of perestroyka in the Armed Forces, of the guidelines of the 19th All-Union Party Conference pertaining to qualitative parameters of defense organizational development, of its essence and ways to accomplish it in the Air Force, in the combined unit and unit. The political section, party organizations and ideological workers do a poor job of influencing the forming of defense consciousness and historical thinking in the men, and they lack a system in their work which would provide a guaranteed forming effect.

The department of Marxism-Leninism, the political sections and party organizations do not devote adequate attention in their activities to problems of historical, patriotic, and internationalist indoctrination of cadets and officers, to forming in them a respect for the past of our party, country, and military, for the fundamental values of socialism and its ideals, and to development of a new view of the prospects of socialist development. For this reason some individuals have difficulty finding their bearings in the diversity of opinions, have difficulty in determining their experiential attitude, come under the influence of rumors and gossip, and are unable to offer a decisive rebuff to attacks on the Armed Forces and to nationalistic and antisocialist manifestations.

Unfortunately these and other deficiencies in ideological work are also noted at the Air Force Engineering Academy imeni N. Ye. Zhukovskiy, and if these deficiencies are intolerable at a service school, they are even more so at an academy which trains leader personnel for the Air Force Aviation Engineer Service.

Why is it that the mechanism of ideological influence sometimes does not function properly?

I believe that one of the reasons is the fact that some instructors in the departments of Marxism-Leninism at military educational institutions lack a clear idea of the substance, extent, and methodology of the work required to form in students the above-listed qualities, as well as the new historical and defense awareness, officer's honor, and intellectual virtue. It is not surprising that in the course of conversations with officers at service schools and in line units we did not hear a clear-cut judgment or scientific determination of the essence of these concepts.

Some might argue that this is all theory, that one should get closer to practical realities and assess practical matters. I have no argument with the statement that there should be a close link with practical affairs. At the same time one must bear in mind that many new concepts which are essential to today's officer are presently coming into scientific and practical use. They include, for example, the concept "defense organizational development on the basis of qualitative parameters."

In explaining this thesis, many cadets, students, and officers at military educational institutions and in line units spoke of military reductions, material incentive for military labor, and the campaign against bureaucracy. And few individuals clearly enumerate the directions and areas of qualitative changes in defense organizational development as stated at the 19th All-Union CPSU Conference: military science, equipment, strength and composition of the Armed Forces, and the human factor in its full diversity.

Of course when one discusses new terms, concepts, and problems connected with understanding them correctly and with transforming them into subsequent convictions and actions, one must know these concepts. Without claiming rigorous scientific procedure, and basing my presentation on the opinions of other authors, I shall state several formulations.

New military-political thinking is a system of views, ideas, and theories which express the essence of the concept of perestroyka in the Armed Forces, in conformity with the requirements of guideline documents of the USSR Minister of Defense and the Chief of the Main Political Directorate of the Soviet Army and Navy, ways and means of its implementation taking into account the points of the new Soviet military doctrine and the 19th All-Union Party Conference on qualitative parameters of defense organizational development.

Political knowledgeability of the Soviet officer is a solid, strong fusion of knowledge, convictions and actions which constitute a fundamental description of his character and person. This is the political, active aspect of the individual, inseparably linked to the tasks of the campaign for perestroyka and for achieving excellent qualitative results in combat and political training.

The category "political knowledgeability" includes concepts both of politics and culture, and thus reflects not only the level of an individual's political development but also his ability for political activity, habits and skills in this area.

Level of legal knowledgeability—an aggregate of socially useful qualities which are manifested in the daily life and job-related activities of military personnel, grounded on knowledge of the law and an inner need for unswerving observance of the law and on a correct understanding of laws and their application.

Level of moral-ethical awareness—aggregate of standards of Communist ethics and morality, a socialist way of life and civilized conduct, honor, duty, and intellectual worth and dignity, which is manifested in an officer's daily life and job-related activities, grounded on knowledge of these elements and an inner need to implement them unwaveringly.

Level of defense awareness—an ideological phenomenon which constitutes reflection in people's mass consciousness of the actual politico-military processes taking place in the world today. It is essentially awareness by people of the need to defend the state and the societal system against possible military attack, and the elimination of aggressive intentions, attitudes and actions from a position of strength in relations with other countries. It is grounded on an understanding of the actual economic, political, spiritual-intellectual and social capabilities of the state to provide reliable defense against any and all aggressive actions.

Our surveys and interviews indicated that many cadets, students, and officers at military educational institutions have poor knowledge of the Leninist lessons of perestroyka contained in the last speeches and articles of V. I. Lenin, in which he repeatedly spoke of reorganization, of new organization of the basic foundations of people's lives and thinking, about a turning point, about changes in our country's destiny, about a new orientation in party policy and Soviet rule, about the breaking of rigid patterns, about elaboration of new approaches, methods, and modes of activity, and about the need to study and relearn, to educate and reeducate people. A genuine wellspring of wisdom and knowledge is to be found here! Theory and methodology of perestroyka are presented in detail in the following books: "Perestroyka i novoye myshleniye dlya nashey strany i dlya vsego mira" [Perestroyka and New Thinking for Our Country and for the Entire World] by M. S. Gorbachev; "Na strazhe sotsializma i mira" [Guarding Socialism and Peace] and "Verny otchizne" [Faithful to the Homeland] by D. T. Yazov; "Zashchita Otechestva: chelovecheskiy faktor" [Defense of the Homeland: The Human Factor] and "Put peremen, vremya deystviya" [Path of Changes, Time of Actions] by A. D. Lizichev. The ideas expressed in these books offer a guide to action.

In view of all this, I believe that it would be appropriate to recommend to political agencies, party committees and bureaus, ideological institutes, and departments of Marxism-Leninism at Air Force higher educational institutions that they pay greater attention to resolving the problems stated above. On the basis of all-out intensification of Marxist-Leninist training, ideological-moral and legal conditioning of cadres, active and purposeful efforts must be directed toward forming in cadres the new military-political thinking, a high level of political, legal, and moral-ethical awareness, historical and defense consciousness, intellectual worth and dignity, and the skills of educational and indoctrination work with personnel. To quote Lenin, the entire point right now is for the vanguard not to be afraid to work on self-improvement, to make changes, frankly to acknowledge its inadequate level of preparedness and insufficient ability.

And it is precisely command and political personnel, party and ideological activists, and Communist officers who in all places and in all things must serve as implementers of perestroyka, supporting and implementing party policy and the guidelines of the 19th All-Union CPSU Conference directed toward qualitative parameters in defense organizational development.

At the present time we must note, however, that work by people in the line units is poorly coordinated with the activities of the departments of Marxism-Leninism at Air Force higher educational institutions. The interests of the job at hand demand closer coordination and mutual augmentation. This will promote enlistment in practical activities of a scientific view of this issue and, on the other hand, will ensure that departments of Marxism-Leninism are equipped with current practical experience. Theoretical and scientific-practical conferences with the participation of social scientists in the line units and comrades from line units at military higher educational institutions could prove useful, as well as collective study of the theoretical and methods literature and conduct of various research studies both sponsored within departments and among the officers of units and subunits.

Special attention should be focused on improving the ideological-theoretical conditioning of command and political personnel. Toward this end I would recommend fuller use of instruction at service academies, in academic courses of training, at universities of Marxism-Leninism, at theory seminars, political and scientific-practical seminars, as well as participation in productive discussions and debates, conferences, and lecture organizations.

And, finally, here is one more important item: implementation of the demands of 19th All-Union Party Conference and the CPSU Central Committee decree entitled "On Radical Improvement in Legal Education and Organization of Universal Law Education in This Country." We are moving too slowly. It is essential to step up work efforts and to concentrate main efforts on ensuring thorough knowledge by officer cadres of the fundamental laws of the Soviet State and the requirements of the new general service regulations. Instruction classes on the fundamentals of Soviet laws should be organized at military educational institutions, at universities of Marxism-Leninism, and within the Marxist-Leninist and commander training system. In general we have plenty of various forms of instruction. We must learn to use them effectively, to respond promptly to all new developments and changes, and not to lag behind the requirements of perestroyka.

I shall repeat it once more: problems pertaining to developing in Air Force personnel the new military-political thinking and a new level of political, legal, and moral-ethical awareness is an issue of a fundamental nature, I would say. As is emphasized by USSR Minister of Defense Army Gen D. T. Yazov, international detente has been achieved precisely due to the new political thinking and the constructive position taken by the USSR. The "cold war" period is yielding to a period of peace and cooperation. Due to present circumstances, however, there are no grounds for complacency or lessening of vigilance. It would be naive to assume that Western political circles seriously intend to help in our perestroyka. No, we hold the fate of perestroyka in our hands alone.

Of course we link perestroyka with peace. It is for this reason that Soviet peace initiatives are so important, including initiatives pertaining to armed reduction, reduction of the Armed Force, and conversion of the defense industry. But we must not forget that imperialism, regardless of what it may claim, recognizes only a state's actual political, economic, and military power. Therefore strengthening of this country's defense capability and increasing Air Force combat readiness remains task number one for Air Force personnel.

The restructuring processes which are presently in motion encompass all aspects of our lives. They contain a great deal which is difficult to take in. Nor can Air Force personnel live in isolation, apart from common problems. "All of us," stated M. S. Gorbachev at the July 1989 CPSU Central Committee Conference, "must realize this and act as a revolutionary party, for otherwise there will be forces which, seeing that the party is lagging behind, will attempt to seize the initiative." This means that officer-Communists must become even more actively involved in this country's political affairs, especially during the period of preparations for and holding of elections to republic and local soviets of people's deputies.

We must learn to work in the new conditions, and we must mandatorily move forward, reinforce the prestige and authority of political agencies and party organizations with specific deeds. This is a demand of the times, a demand of perestroyka.

Computers Help in Air Force Personnel Daily Work

90R10007H Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 10, Oct 89 (signed to press 12 Sep 89) pp 18-19

[Article, published under the heading "For a High Degree of Combat Readiness," by Col O. Zdorov, candidate of military sciences: "Electronic Helpers"]

[Text] A focus on qualitative parameters in defense organizational development requires a search for new work methods. It is necessary to increase the combat readiness of Air Force combined units and units, however, improving three components of combat readiness—combat capability, combat mobility, and combat survivability—without increasing material expenditures. The problem can be resolved by improving quality of planning and degree of validation of adopted decisions, selection of reasonable variations and modes of actions on the basis of comprehensive operational-tactical calculations and modeling. And computers will help accomplish this.

Several directions and areas are being examined in work on this question by line units, scientific research institutes and Air Force educational institutions. The first area involves using Elektronika BZ-34 and Elektronika MK-52, -54, -61 programmable electronic calculators. They are the most widely used, available, reliable, and easily carried. In spite of limited memory capacity, programmable electronic calculators are suitable for solving fairly complex problems. For example, the program developed at the Military Air Academy imeni Yu. A. Gagarin by Maj A. Kuzmin, which takes up 98 memory locations in an Elektronika MK-52, provides capability, using the Runga-Kutta method, to integrate differential equations of the motion of an aerial bomb taking into account air resistance, avoiding the need to use unwieldy ballistic tables.

There are in addition about 200 programs available at the academy for statistical processing of the results of weapons delivery, for conversion of coordinates, and mission-preparation of navigation systems; for estimating the capabilities of ground navigation systems, conditions of natural lighting, detection of ground targets, and modes of target approach; calculations for forming up and breaking formations; calculations on ensuring flight safety from a navigational standpoint and determination of tactical operating radius; calculation of various aerodynamic, ballistic, meteorological elements, etc. Two special manuals have been published for line

units, but only in a small number of copies (approximately 1,000 copies each). At the end of this year, however, Voyenizdat is planning to print 30,000 copies of a reference manual entitled "Primeneniye programmiruyemykh mikrokalkulyatorov v aviatsii" [Using Programmable Electronic Calculators in Aviation], containing 100 programs developed by Col A. Kaynov (bookstore ordering code: KB-1-14-189).

Similar work is actively in progress at the Yeysk and Kharkov Air Force schools, as well as in line units, by volunteer-enthusiast pilots, navigators, engineers, and technicians. We should mention officers V. Dmitriyev, V. Marusin, V. Peshekhonov, A. Podgayko, V. Sokolov, S. Kharlamov, and A. Yakovenko. Both they and many others are receiving considerable support from the Air Force Navigation Service, from the other Main Staff directorates, and from Air Force large strategic formation and combined unit headquarters staff sections. Amassed experience suggests that one should not underrate the possibilities of programmable electronic calculators. These devices are always available and provide capability to perform required calculations quickly and accurately.

We shall also note certain shortcomings: first of all, the impossibility of entering or loading programs from magnetic cards and documenting results. These weak points are to be corrected in new models planned for regular commercial manufacture. But nevertheless limited memory and slow operating speed rule out solving a number of highly-complex computation and, particularly, information problems.

In this connection a second direction being taken in using computers in line units consists in utilizing regular available computers. The SM-2M, -1420, and M-6000 medium-category computers used in cockpit data recorder tape systems and cockpit simulator systems are general-purpose computers. Several dozen programs have been developed at the Military Air Academy imeni Yu. A. Gagarin for these computers: calculation of flight data and setup data for navigation systems, engineer-navigation calculations, selection of optimal weaponry and conditions of weapons employment, validation of optimal tactics, evaluation of air-to-air combat engagement (airstrike) results, etc.

A software package of programs providing operational-tactical calculations for navigation and weapons delivery for the SM-2M computer has been duplicated on magnetic tapes and has been adopted in a number of Air Force regiments. A manual for performing navigation calculations on the SM-2M and M-6000 computers has been published. Software is being developed for the SM-1420 computer, dealing with fighter tactics. In addition, some of the software for the standard available computers are being converted from programmable calculator programs, to provide capability to document results, as well as conversion of software developed for the YeS-1030 and -1045 mainframe computers.

Several other useful suggestions have been made, aimed directly at improving the operational readiness of Air Force units. For example, a tactical bomber flight automatic programming system developed by Lt Col G. Dudin for the M-6000 computer makes it possible to reduce by a factor of six the time required for mission planning, improving quality of planning, and avoiding possible errors. A similar system, for fighter-bombers, was developed by Col (Res) V. Savchenko. Academy specialists have proposed means of interfacing computer output devices with aircraft onboard computer mass storage devices and keypunch machines for flight program entry and automated preparation of punched cards which would find use in line units.

Using standard-equipment computers for purposes for which they were not originally intended involves certain difficulties. These include the presently limited availability of machine time and expendable materials, the fact that these computers cannot be used during operations when subunits are away from their home field, considerable distance between computer location and command post or headquarters, limited number of problems which can be processed concurrently, and lack of means of entry and display of graphic operational-tactical information. Nevertheless they can be utilized fairly extensively.

A third area involves using for line-unit purposes computers of various types which are not part of standard facilities and equipment: the DVK-2M, -3, Elektronika DZ-28, Elektronika-60, -85, SM-4, -1800, -1210, Iskra-226, and Agat, the Mikrosha, BK-0010, -0011, PK-100 and other home computers, and, in the future, YeS-1840, -1841, -and 1845 personal computers as well.

The fourth direction involves performing calculations on order on large mainframe computers at EDP centers. The advantages of the latter include unlimited software, high speed, capability to solve several problems concurrently, and a large variety of input/output devices. There are more than 400 operational-tactical problems and models at the Military Air Academy imeni Yu. A. Gagarin; many of these have already been passed on to the computer centers of military districts and service schools. The fact that local users are scattered over a large area, however, means that they do not obtain the requisite data very promptly. This time can be reduced by setting up communications between computers for information exchange, and by establishing extensive computer networks. In the latter case mini-computers in the units will function as terminals for large strategic formation mainframes and will provide capability to perform calculations in a prompt manner.

The time is coming when the main problem in the area of computerization will be not a shortage of computer hardware but inadequate development of computer software. Presently on the agenda is the question of developing software in advance of need. This requires preparing lists of necessary calculation and informational tasks for the various Air Force components, performing

intercoordination and linking into systems, followed by establishment of personal-computer-based databases and networks.

This is already being done at the Military Air Academy imeni Yu. A. Gagarin. They have even found ways to handle algorithms which make it possible to perform calculations using programs the total size of which exceeds available RAM.

A large contribution toward computerization in line units is being made by volunteer computer enthusiasts, who understand the advantages of computers and are extremely computer-knowledgeable. They have developed a number of software applications in the area of tactics of Air Force components, flight dynamics, and various types of operations support. Use of this software will greatly increase the effectiveness of performance of combat training tasks.

It is correctly said that computer technology is not so much new hardware as it is a new way of thinking. In the unit with which Lt Col A. Yakovenko serves, for example, they have set up a computer facility consisting of an Elektronika-60 and an Alfa-BK. Officer A. Kukhtin has designed and built devices to convert Alfa-BK computer output signals into Morse code and has interfaced the computer with an RTA-80 telegraphic terminal, which has provided capability to document received data.

At the same time the adoption of computers sometimes becomes an end in itself and leads to other results. In a certain Air Force large strategic formation, for example, they have hooked up a display panel to an Elektronika DZ-28 microcomputer to display the state of operational readiness of subordinate combined units and units. Data entry has proven to be a bottleneck in this unquestionably needed system. Data entry was being handled by a single operator and took considerably more time than the entire process using the traditional mode (based on reports by several liaison officers). Obviously positive results can be obtained from automation only with a comprehensive approach, focused on "equal strength" of all phases, when a computer is used in fact to improve work performance, not merely because this is the computer age.

In the future personal computers can and should become the principal computer hardware in line units. They can be used to set up local area networks, with personnel working jointly on combat documents, as well as specialized tactics classrooms and similarly-used electronic pilot and navigator training simulators. Adoption of such systems will make it possible to raise the quality of combat training to a new and higher level.

Of course this involves certain expenditures. But they are more than repaid by reduction in time logged aloft practicing tactics and variations of actions as a group or in conditions of hostile weapons delivery and ECM, and this practice also results in greater flight safety.

It is useful to provide official-use personal computers with input/output devices to handle graphic operational-tactical information and, if needed, with digital cartographic information processing modules and appropriate software. It is extremely necessary to link personal computers to aircraft onboard digital computers for remote entry of flight programs and tactics parameters, for reading data for the purpose of gathering statistics, maintaining records and preparing for flight critique and analysis.

A large number of programs of interest to line units are available at design offices, scientific research institutes, and at defense industry enterprises. This software provides capability to devise tactics and assess their effectiveness, but at the present time it is being used as a rule only at the stage of developing new aircraft, by a fairly small group of specialist personnel. Advance preparation of such software and its provision to Air Force regiments after aircraft enter operational service would make it possible substantially to increase the effectiveness of tactics research.

Practical considerations demand that common base models of Soviet and foreign combat equipment be available everywhere (aircraft and weapons systems, air defense assets, command, control and support facilities). At the present time uniquely "local" equipment is in use practically everywhere. This results in repeated duplication of activities and excessive expenditure of funds. This work should be given precise coordination, taking into account future prospects of computerization.

Comprehensive exchange of information in the periodicals on matters pertaining to incorporating computers in operations, developing algorithms and computer programs for various operational-tactical calculations, planning and scheduling combat training, record keeping and reporting, development of specialized classrooms, nonstandard computer centers, devices for interfacing computers with other systems, as well as efforts against computer "viruses" can speed the process of adoption of computer hardware. There is no doubt whatsoever that synthesis and utilization of advanced know-how will foster improvement of command and control of forces and assets, the process of decision-making and decision validation, and shortening preparation time for combat operations, that is, increasing the operational readiness of Air Force combined units and units.

* * *

From the Editors

Dear readers! We would like to ask you to share your experience and know-how in using computers in the work activities of commanders and staffs, command and control facilities, flight personnel, engineers and technicians, and support unit specialist personnel. We would also like you to send us materials on the establishment and functioning of computer facilities and data centers

resulting from volunteer initiative and on the new elements they are introducing to practical training activities. This magazine in turn will provide our readers with information on the most interesting projects in line units, at scientific research establishments and Air Force educational institutions.

Starting next year, the editors are planning regular publication of materials on using programmable electronic calculators to perform various operational-tactical calculations. Send in programs you have developed. The description should include the source code, manner and procedure of preparation and entry of input data, a test solution, and an assessment of the anticipated effect. Length should be one or two double-spaced typed pages. We are looking for only those problems which are of practical interest to a broad group of Air Force specialist personnel.

Subscribers will receive detailed information on the latest in computer hardware and will have available a number of programs needed in one's daily work.

Failed Soviet Phobos Mission Detailed

90R10007I Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 10, Oct 89 (signed to press 12 Sep 89) pp 20-21

[Article, published under the heading "Responding to Readers' Questions," by Doctor of Technical Sciences Professor N. Ivanov: "Phobos 2: Navigational-Ballistic Mission Support"]

[Text] **The Fobos-2 [Phobos 2] unmanned interplanetary probe was more than 260 days into its mission. Communications with the space vehicle were lost only 10 days before the scheduled landing of a long-lived autonomously-operating lander probe and automatic bounder vehicle. The general public and mass media proceeded to sound the alarm: public moneys were being wasted. It was at this point that Academician R. Sagdeyev, as a candidate for election as a USSR People's Deputy, advanced the following as one of the planks in his campaign platform: "Restore the Soviet people's confidence in the space program." Little was reported in the press on the results of the Phobos mission. This is why we are once again returning to this topic.**

In 1988 Doctor of Technical Sciences Professor N. Ivanov authored an article in this magazine on ballistic support services for this mission. In the following article he tells us about the flight of the unmanned interplanetary probe to Phobos and relates what it has given to science.

* * *

The process of putting Phobos 1 and Phobos 2 on their way—the two vehicles were launched on 7 and 12 July 1988 respectively—was successful, and even produced substantial fuel savings in comparison with the nominal figures. Course correction burns were made during the first 10 days in flight, and the probes proceeded toward Mars. Subsequent events, between July 1988 and March 1989, were on the whole in conformity with the mission program. But reality introduced substantial adjustments into implementation of the unmanned interplanetary probes' flight program.

Things became tense for the ground team following the foolish loss of the Phobos 1 probe. Steps were immediately taken to prevent the possibility of similar mistakes in handling the remaining probe. In particular, the program for inserting Phobos 2 into a Mars orbit was revised.

Prior to the mission the control strategy called for two flight path adjustments as the probe was approaching Mars: at the beginning of January 1989 and three or four days prior to entry into Mars orbit, at the end of January 1989. Following thorough analysis of all alternative variations, however, only one adjustment burn was performed, on 23 January 1989, changing the probe's velocity by 21 m/s.

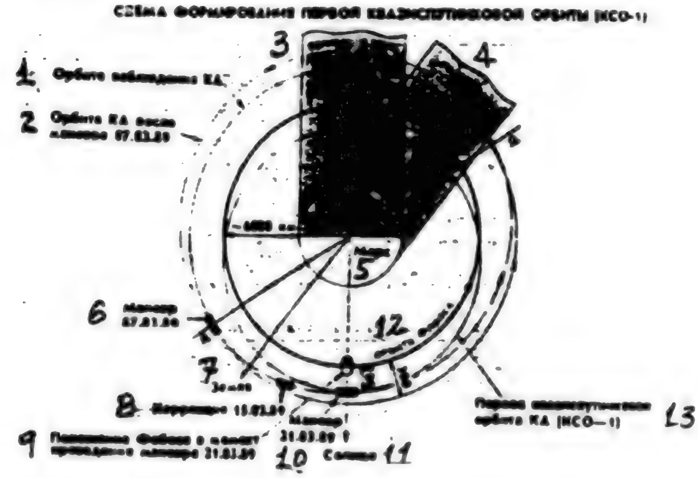
This decision took three factors into account. First, fuel had been saved during the post-liftoff phase; second, the ballisticians had sufficiently precisely determined the probe's flight path; third, the probe's target orbital pericenter altitude had been raised to 800 km. The latter factor somewhat worsened the operating conditions of the scientific instrumentation for studying Mars and the Mars-adjacent medium, but in order to improve reliability of probe control from earth they chose this variation for insertion into Mars orbit.

On 29 January 1989 controllers commanded an 815 m/s deceleration burn, and the probe entered Martian orbit. Altitude above the planet's surface at the lowest point was 876 km, and 80,170 km at the highest point. Inclination to the plane of the Martian equator was 1.0°. Orbital period was slightly less than 78 hours.

During the next two weeks Mars was scrutinized from fairly low altitudes in the vicinity of the pericenter, after which, on 12 February 1989, the probe was moved into a new transfer orbit. The phase of accomplishing the task of approaching the Martian moon Phobos commenced at this point.

The fact is that the problem of approaching Phobos and placing the lander probe onto the Martian moon's surface is extremely complex and difficult. Using traditional techniques and methods was out of the question. In fact, we could not immediately direct the probe toward Phobos because, among other things, we did not have precise knowledge of its orbital path or position. At the moment the unmanned interplanetary probe was launched, we knew the position of Phobos to within 100-150 km, while this had been reduced to 20-30 km by mid-February 1989. But accomplishing a landing required precise knowledge of its position, to an accuracy of within a few kilometers.

Diagram of Establishment of First Quasi-Satellite Orbit (QSO-1)



Key:
1. Probe vehicle observation orbit
2. Probe vehicle orbit following maneuver on 7 March 1989
3. Sun shadow zone
4. Radio transmission shadow zone
5. Mars
6. Maneuver on 7 March 1989
7. Earth
8. Correction on 15 March 1989
9. Position of Phobos at moment of maneuver on 21 March 1989
10. Maneuver on 21 March 1989
11. Sun
12. Phobos orbital path
13. Probe vehicle first quasi-satellite orbit (QSO-1)

It would seem to be a simple task: insert the probe into orbit around Phobos and refine the parameters.

But Phobos cannot maintain its own satellite: its mass is 10^8 smaller than that of Mars, and its gravity is so small that in order for a lander vehicle simply to hold to its surface, it would have to anchor itself into the soil in some fashion. Because of this restriction it was necessary to follow a long, indirect procedure: to bring the probe to Phobos with a series of maneuvers and flight path adjustments, gradually bringing its plane of motion, orbital period, etc to values identical to those of Phobos.

The landing on Phobos was to take place in the first 10 days of April. During the remaining time, the ballisticians not only had to determine the probe vehicle's orbital path but also to obtain refined figures on the orbital path of Phobos, its shape and configuration, select a landing site, and select landing conditions.

By performing an adjustment maneuver on 12 February 1989, the probe vehicle's pericenter was raised to the orbital path of Phobos. Another maneuver was executed six days later. As a result the probe was placed into a so-called observation orbit, with a radius approximately 300 km greater than that of the Phobos orbit. Once every seven days the probe vehicle and Phobos would close to minimum distance (about 300 km), which provided favorable conditions for observing the Martian moon.

This was followed by two additional maneuvers, and the probe vehicle was inserted into a first quasi-satellite orbit (QSO-1), which provided the most favorable conditions for imaging Phobos by TV camera: at any given moment the probe was not more than 200-600 km from the Martian moon. An additional two maneuvers remained, to place the probe vehicle into QSO-2—on 2 and 6 April. 7 April was to be the date on which the probe would approach to several tens of meters above the surface of Phobos, with subsequent descent of the lander vehicle.

Unfortunately the rendezvous never took place. They were just 10 days short of accomplishing this maneuver. Many people were disappointed by the mission failure, and the mass media immediately lost interest in this project. This is why we feel it is necessary to inform our readers about the results of this mission.

First of all we should note that a new method of space vehicle navigation was used for the first time in conjunction with an unmanned probe mission and was successfully perfected, a method involving use of TV images of

a celestial body of complex shape, such as the Martian moon Phobos. The necessity of employing this method was dictated by the exceptionally stringent requirements on determining the relative position of the probe vehicle and Phobos (within 1-2 km) in order to accomplish a landing on the surface of Phobos.

This method consists essentially in the following. Picture two objects following their own individual flight path. One of these objects conducts imaging of the other, which is unsymmetrical and of complex shape, at a certain predetermined frequency interval. The resulting photographic image of the second object will be determined by many factors: the two flight paths, relative distance, imaging radius, conditions of illumination, etc. If data on the shape of the target object are known in advance, one can reproduce the conditions of imaging and, as a result, determine their flight paths. This is the central idea behind this method of navigation.

At the first stage of solving this navigation problem, the output information did not consist of the flight paths of the Phobos 2 probe but rather certain inertial angles between a given invariable direction in space and the bearing toward the geometric center of Phobos at each moment of imaging. Another specific feature of practical implementation of this method was the fact that the data from the television imaging performed aboard the probe vehicle were transmitted to earth, with signal passage taking more than 10 minutes. All information was processed back on earth.

Here they developed a theoretical mathematical model of the shape of Phobos and corresponding software providing capability to reproduce the theoretical shape of Phobos for various conditions of observation, with various illumination of Phobos by the Sun, and taking into account craters existing on Phobos, which can be used as certain reference points.

Inertial, "platform-aspect" angles were determined with a sufficient degree of accuracy by comparing theoretical images with TV images actually obtained by the Phobos 2 probe, angles which made it possible to obtain refined data not only on the relative position of the probe and Phobos but also their orbital paths. This complicated method, but the only possible method, was selected for navigation of the Phobos 2 unmanned probe.

Using inertial angles obtained as a result of direct TV observations of Phobos, in combination with highly-accurate trajectory measurements of the Phobos 2 probe from earth, as well as data obtained from terrestrial astrometric observations of Mars and its moons, made it possible to accomplish the task of constructing a highly-accurate theory of Phobos motion. This is one of the basic results obtained during the Phobos 2 unmanned probe mission.

Everybody knows that it is possible to travel to any celestial body only with accurate knowledge of its mechanical trajectory, in order to know at all times its coordinates and velocity components for accomplishing the task of effecting rendezvous with this body. The exceptional nature of this problem is acknowledged by scientists worldwide, as indicated by the fact that European and U.S. experts have been enlisted to solve this problem. Practically all astrometric information from terrestrial observations of Mars and its moons as well as data from separate observations of Phobos and Mars made by the U.S. Mariner and Viking unmanned vehicles were placed at the disposal of Soviet scientists. Processing of all this data made it possible to determine more precisely the position of Phobos at the moment the probe vehicle entered a satellite orbit by a full order of magnitude. TV images subsequently made it possible further to improve the accuracy of the initial data by a factor of more than 20. All this helped develop a theory of motion for Phobos which makes it possible to predict its motion many years into the future with a high degree of accuracy and, consequently, substantially to simplify the strategy for approaching Phobos on future missions. At the same time one additional basic figure was obtained—the gravitational parameter for Phobos. We now know that this parameter equals (7.22 plus over minus 0.05) x 10^{-4} km^3/c^2.

This mission also resulted in another unique accomplishment. The classic three-body problem was solved in a practical manner for the first time in the history of space flight, when the Phobos 2 probe was brought into a stable quasi-satellite orbit around a small celestial body. The accompanying diagram shows how this orbit was achieved. Practical achievement of QSO-1 required two maneuvers, one correction, and more than two weeks time. A number of conditions and restrictions were observed in the process, in particular pertaining to radio communications line-of-sight from earth tracking stations, the probe being blocked by Mars, the sun, as well as many other factors. For example, the final maneuver for transfer into QSO-1 on 21 March 1981 was executed at a moment when Mars, Phobos, the probe vehicle and the sun were all in alignment, while the distance between the probe and Phobos did not exceed 200 km.

These conditions were established by means of maneuver and subsequent correction, performed on 7 and 15 March. The slightest errors in their calculation and execution would have resulted in failure to meet the above conditions. In short, this required exceptionally accurate work by the ballisticians in performing calculations, and no less accurate execution of maneuvers and corrections by onboard systems.

It is evident in the diagram that the probe vehicle and Phobos, constituting satellites of Mars, have practically identical orbital paths, displaced by only 200 km relative to Mars. A striking effect is achieved as a result. Although the gravitational pull of Phobos is extremely weak, it holds the probe vehicle to a distance of not more than 400-500 km. Depending on the relative position of the probe vehicle and Phobos, the latter alternates between decelerating and accelerating the probe, preventing it from moving away to a greater distance. As a result Phobos acquired a quasi-satellite—essentially a

Martian moon. It is in close proximity to Phobos at all times, acting as a moon of Phobos as well, as it were. This orbit is stable, a condition attained by making the planes of motion and the orbital periods of the unmanned probe vehicle and Phobos practically identical.

Even more stringent demands are imposed in establishing QSO-2, when the probe vehicle is brought down to a distance of 50-60 kilometers from Phobos, with subsequent descent to and landing on the surface of the Martian moon. The fact is that the terminal phase of the approach to a few dozen meters from the surface of Phobos is totally executed in automatic mode, with all onboard systems operating autonomously, while capture of Phobos by the radar altimeters carried aboard the probe vehicle cannot be accomplished until the distance is reduced to not more than 50-70 km.

A great deal of experience in ballistic-navigational support for control of complex space vehicles, including cooperation not only within the USSR (Mission Control, IPM, NITs, IKI, etc), but international cooperation as well (NASA, KNES, ESOC) was amassed in the course of the mission and control of the Phobos 2 unmanned interplanetary probe, experience which unquestionably will be utilized in the future in carrying out other space projects.

Mountain-Terrain Tactical Bomber Strike Tactics

90R10007J Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 10, Oct 89 (signed to press 12 Sep 89) pp 24-25

[Article by Military Pilot 1st Class Col V. Tolkov, candidate of military sciences: "Bomber Operations in Mountains"]

[Text] **Delivery of Strike by Element Leader With Diversionary Maneuver by Wingman**

During the conduct of combat operations in mountain terrain, priority targets for tactical bombers include troops and vehicles on roads, fortified positions, bridges, river crossings, tunnels, etc. The adversary will therefore endeavor to provide these targets with strong protection against air attack. This fact will make it necessary to assign special elements to suppress local air defense assets or will require that bombers employ tactics which ensure attack on the target with the element of surprise.

Strike delivery by the element leader with diversionary maneuver by his wingman is a standard tactic used by a two-ship element. This tactic consists essentially in the following. At the calculated point of initiation of run on the target, a point at which the bombers cannot be detected by hostile radars, the element leader descends and proceeds toward the target using terrain masking: along valleys, gorges, mountain ridges, etc. Simultaneously the wingman, climbing to higher altitude and increasing airspeed, allows himself to be detected. He tracks a course which is from 60 to 90 degrees off that of the element leader. Just prior to coming within effective range of local air defense assets, he executes a maneuver and commences a run to attack local air defense assets, diverting the attention of the weapon crews. At this moment the element leader appears above the target and attacks it. When necessary the element leader flies a second pass on the target or on antiaircraft weapon positions.

[See graphic on p 23]

Complaints About Difficulty of Blackjack Bomber Servicing, Maintenance

90R10007K Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 10, Oct 89 (signed to press 12 Sep 89) pp 26-27, 30

[Article, published under the heading "Soviet Defense Potential: Qualitative Parameters," by Lt Col V. Dolgishev: "The Tu-160: Strategic Parity Aircraft"]

[Text] A great deal is changing today in the USSR Armed Forces. A policy of glasnost and a defense-oriented Soviet military doctrine are opening up, frankly speaking, what in the past were at times excessively "secret doors." Some time back it would have been difficult to imagine that a "field trip" by representatives of various newspapers and magazines would be arranged to a guards strategic bomber regiment base at which the new Tu-160 missile-carrying supersonic bomber is being tested. And at an even earlier date this aircraft was shown to a U.S. delegation headed by Chairman of the U.S. Joint Chiefs of Staff Admiral W. Crowe.

The admiral clambered up a steep ladder into the cockpit, closely scrutinized the flight deck instruments and equipment of what until recently had been a top-secret strategic bomber, and listened to a detailed briefing.

"What I saw," the high-ranking American visitor acknowledged, "made a strong impression on me. This is world-class equipment and is operated by highly-skilled specialists."

This graceful bomber, painted entirely white, contrary to its NATO designation—Blackjack, apparently an analogy to the famous corvette which entire squadrons were unable to catch, is not merely a new military aircraft but is a qualitatively different piece of military hardware, which carries weapons of devastating force a distance of thousands of kilometers.

The Tu-160 is the pride of the Soviet Air Force. Reflected in this aircraft is the principle of sufficiency of Soviet defense might, which means that our arsenal should contain not only a reliable shield, but a lethal sword as well, capable, following the law of retaliation, of instantly nipping in the bud a surprise attack by any aggressor.


ДЕЙСТВИЯ БОМБАРДИРОВЩИКОВ В ГОРАХ
H=100-150 m
H=200-300m
H= 2000— 2500 м
Release of heat flares

This supersonic multimode missile-armed aircraft is the Soviet response to the U.S. B-1B bomber.

"Yes, it is our pride," Lt Gen Avn P. Deynekin, Commander, Long-Range Aviation [strategic bomber force], says about the Tu-160. "And our strategic bomber pilots are genuine professionals. They are capable of maintaining the highest level of skill over the course of a flight lasting many hours, sometimes as much as 24 hours, and they are capable of being continuously ready and prepared for any emergency situation. The fact is that in the air one must work continuously. Of course automatic control systems help, but they must be monitored and adjusted. Experts maintain that the work and stress load on the strategic bomber pilot on an extended flight greatly exceeds that of a truck driver on a busy highway. And we certainly do not need to mention the heavy burden of responsibility on the strategic bomber pilot."

The men of the guards Air Force regiment under the command of Gds Lt Col V. Gorgol have accomplished a great feat. They had the job of "shaking down" this aircraft under line-unit conditions. Decrease in time available to bring aircraft into operational service following completion of the design and development phase is a problem of the world aircraft industry which is becoming increasingly more complex. Industry is no longer able to handle the testing of highly-complex systems. This task must be accomplished by test operation under line-unit conditions.

The first flights were initially made on a single aircraft. Turnaround procedures for relaunching would be performed right on the runway, without taxiing to the ramp. A substantial contribution toward accelerated mastery of this highly-complex equipment was made by Maj Gen Avn L. Kozlov, officers V. Selivanov, V. Grebennikov, V. Gorgol, Ye. Ignatov, V. Kurgannikov, A. Medvedev, N. Studitskiy, V. Shcherbak, and others. Maj Gen Avn V. Yegorov, Chief Navigation Officer, Long-Range Aviation, has accompanied the Tu-160 along the entire way, from the first rough drawings to long cross-country flights and to combat flying. Lt Col I. Anikin (this Air Force regiment's senior navigation officer at that time) and Gds Maj S. Trofimov, Yegorov's comrades in arms and pioneers on the Tu-160, mastered the aircraft just as thoroughly.

One can scarcely exaggerate the role of the navigation service. During a flight air navigators have an enormous work load. Their tasks include plotting course, determining position, operating aircraft systems, "defense" against enemy fighters and, finally, delivering a devastating "retaliatory" strike, which does not leave the aggressor the slightest chance of acting with impunity. Of course it would be impossible to accomplish all this without the ultramodern gear with which the Tu-160 is equipped. During a flight a total of more than 100 different computers are operating aboard this aircraft.

Thus this four-engine swing-wing strategic bomber has been shown to the general public for the first time. Some of our most knowledgeable readers will probably see a resemblance between the accompanying photograph of the Tu-160 and the U.S. B-1 bomber, which is tasked with striking the enemy with long-range cruise missiles in the deep rear areas of continental theaters and over the oceans. Both aircraft have an integral variable-geometry wing with substantial, sharply-swept fixed root panels. Both are powered by four engines mounted in pairs in nacelles under the rear part of the wing. Both have a cruciform tail assembly. Both contain weapon bays forward and to the rear of the wing torsion box.

This similarity does not indicate, however, that the designers copied somebody else's design, but rather indicates a similarity of approach by aircraft design engineers to solving a problem. The problem was to come up with a compromise design which would "reconcile" conflictive requirements: a combination of long range and endurance with potent armament and the capability to penetrate the enemy's defenses at low level at subsonic speeds or at high altitude at supersonic speed.

World aircraft design practice, from the F-111 to the Tu-22M [or Tu-26] Backfire, as well as the B-1, has determined a variable-geometry wing to be the only way to meet all these requirements in a single aircraft, in spite of its complexity, high manufacturing and operational costs.

Back when the Tu-22M was being developed, the Special Design Office imeni A. Tupolev incorporated into a large bomber a basic design arrangement for a smaller aircraft, with engines mounted in the tail section of the fuselage. This resulted in an aerodynamically sophisticated arrangement, in which, however, certain limitations were inherent. In particular, the engines' considerable length of air ducting took up a great deal of fuselage space. Although this can be considered acceptable for a medium-range bomber, such an arrangement is inappropriate for the traditional strategic jet bomber.

An alternative solution is to take the engines out of the fuselage, a solution which limits choice of variations. In addition, aft placement of engines gives rise to serious difficulties connected with aircraft balance and trim. In particular, these difficulties doomed the original design of a Boeing supersonic swing-wing transport aircraft.

The designers could have used a single four-engine cluster, but the arrangement adopted for the Tu-160 and the B-1 is more successful in avoiding problems connected with placement of the weapons bays. With this arrangement the jet intakes are not positioned in line either with the nose wheels or with the weapons bay doors.

In spite of a number of identical design solutions, there are fundamental differences between the Soviet and American bombers, differences which unquestionably explain a great deal. First of all, in the estimate of foreign experts, it is currently the largest combat aircraft ever built. The Tu-160's wing in planform (sweep angles,

aspect ratio, and ratio of the distance between the swing assemblies and wingspan) is closer to that of the Tu-22M than the B-1.

One can consider the designers' attitude toward flight conditions at high altitude and supersonic speeds to be a typical feature indicating their differing concepts. Prior to commencement of flight testing, U.S. Air Force experts rejected for the B-1 the originally-proposed complex combined-compression intakes in favor of external-compression intakes. In addition, the Air Force insisted on fixed air intakes on regular-production B-1B bombers, which offer a reduced radar signature. And although the aircraft continues to be nominally capable of reaching a speed of Mach 1.2 at altitude, in view of the minimal usefulness of such a speed from a military standpoint in comparison with the high cost of consumed fuel, the B-1B must be considered a subsonic aircraft.

Chief designer V. Bliznyuk and the large team of Tupolev engineers did not permit any such compromises in designing and building the Tu-160. They succeeded in creating a qualitatively new aircraft. A grown man can walk right into its supersonic wedge air intakes. The Tu-160's powerplant provides immense speed capability—a speed of 2,200 km/h was reached during one test flight. Attainment of high speed is assisted by the stretched, small cross-section fuselage (by placing the flight deck forward of the nose gear bay rather than above it). The maximum height of the Tu-160 fuselage is not greater than that of the Tu-22M, which is a considerably smaller aircraft. The nose section and flight deck of this new Soviet aircraft are reminiscent in shape to the high supersonic-speed Concorde and to the XB-70, with its elongated radar fairing and greatly sloped-back windscreen.

A no less important question pertains to the correlation between fuel consumption and range at such speeds and fuel economy when flying at high and low altitudes at subsonic speeds. The Tu-160 was designed to have an optimal range both when flying at high Mach numbers at high altitude and in terrain following mode. It goes without saying that any of these modes can be selected for flying a given combat mission, and in certain conditions they of course are combined as required. This of course by no means signifies that the Tu-160 bomber is guaranteed unhindered flight, but nevertheless, as Western experts claim, its capability to penetrate defense in two different modes will stretch out defense forces.

Here is what those who fly the Tu-160 have to say about it.

"The Tupolev people have built a fine aircraft," states Gds Maj A. Medvedev, who was one of the first to master the Tu-160. "It is light in response, easy to fly, and stable in all flight conditions. This is the world's only giant aircraft which can be flown with a stick rather than the conventional control yoke. This 275-ton monster, flying through the atmosphere at twice the speed of sound, is responsive to the slightest control movement. And it lifts off and climbs out smoothly and nimbly, rather than simply heaving off the runway."

Strange as it may seem, takeoff and landing are no more difficult with this enormous aircraft than with its predecessors. The pilots also appreciate the special air conditioning system, with which one can easily maintain a comfortable microclimate on the flight deck. Alphanumeric display provides information in easy-to-read form. Crewmembers are less complimentary about the design of the pilot's and copilot's seats. The fact is that they are not properly designed for long flights. The seat back does not swing down, for example, to a rest position. The same thing applies to the flight suits, which were designed for fighter aircraft. They have a number of complaints about flight deck ergonomics. The fact that the primary and backup flight instruments are of different types, for example, makes it harder to fly the aircraft. This situation is presently being corrected. Other improvements are also being made on the basis of flight crew adverse comments. Unfortunately, however, this process is going rather slowly.

The ground services also have their problems. Mission-readying the Tu-160, which rises like a snowy mountain above almost 20 service vehicles, is a time-consuming, laborious job.

"They failed to consider certain things when they were designing the Tu-160," noted Maj Gen Avn V. Fedorov, Chief Engineering Officer, Long-Range Aviation. "The immense amount of energy generated by the aircraft equipment has a negative effect on ground personnel preparing the aircraft for flight. Measurements have confirmed that the noise and vibration levels are above the maximum allowable. But that is not all. The use of aggressive fluids in the hydraulic systems proves to be an unpleasant surprise to ground crew personnel. There are also other adverse factors. And yet ground personnel not only are not provided with special gloves, footwear, and antivibration belts [sic] but do not even have such basic items as helmets with built-in headset and microphone."

Testing the Tu-160 in a line unit is saving our country millions of rubles. But this has had no effect on the situation of Air Force personnel. All pay, food and clothing allowance figures and personnel categories, such as engineer-technician personnel, for example, have remained practically unchanged. There are hundreds of families on the base without living quarters.

It is necessary to restore social fairness and to make pay commensurate with expended labor. And these guardsmen's labor is truly heroic. Work loads and level of responsibility are unusually high. While spending from 14 to 16 hours a day at the field, and remaining at the field around the clock when necessary, in spite of all the difficulties involved, ground personnel do not complain but are conscientiously making their contribution to the cause of operational readiness and flight safety.

But things cannot continue this way indefinitely. Resolute steps must be taken to eliminate the contradictions between the combat power and propulsion power of this strategic bomber and responsibility for the lives and fate of the millions of people living in the areas where this aircraft flies, on the one hand, and obvious disregard for the needs of these top proficiency-level specialist personnel: pilots, navigators, engineers, and technicians.

The "residual principle" and unfeelingness of financial thinking, which permit saving rubles at the expense of the health and fitness of Air Force personnel, could end up costing a great deal. The command element of the Long-Range Aviation line units is constantly raising the question of the present situation of the Air Force personnel who are operating and maintaining this magnificent ultramodern aircraft. Unfortunately, however, they are being virtually ignored at many levels of higher authority.

Yes, working conditions for ground personnel are not only a far cry from desired conditions, but even from just plain normal conditions. This is one of the most disturbing problems which have arisen during test operation of the Tu-160.

"We are delighted with the aircraft, simply enchanted by its outstanding capabilities. But nevertheless one senses that nobody is 'breathing on the heels' of the Tupolev Design Office. They have a monopoly!" Gds Lt Col Ye. Ignatov, the regimental deputy commander for aviation engineer service, stated his opinion.

Lt Col V. Gorodzeyskiy added: "The Tu-160 is impressive. It is the very latest in aviation, representing a qualitatively new level. But although the aircraft is nice for the pilots, it is difficult for ground personnel. Servicing and maintenance are difficult and inconvenient. It was designed as if the caring hands of regimental aircraft maintenance personnel would never touch its components and assemblies. We are also having a lot of problems with documentation. The people at the design office did not concern themselves with this. And why should they? After all, the Tupolev people have a total monopoly in this area of aircraft design and engineering. If there were any competition, the Air Force would not be compelled to gain flying proficiency at the cost of working conditions which are physically and emotionally exhausting."

Experience in operating the Il-78 tanker aircraft in Long-Range Aviation indicates how one can approach in a different manner that most complex system in aviation, the human factor. This aircraft flies beautifully. Servicing and maintenance are easy and convenient. Well-prepared documentation is available. Many other items have also been thoroughly thought out. The Tupolev people should also give some consideration to ground maintenance personnel.

Here is another question. How long will the human factor continue to be ignored by the management echelon? If you think about it, it becomes clear that the situation could be appreciably improved right now. For example, personnel has not yet been brought up to full strength levels in all units. There have been considerable savings as a result of this. Why not redistribute a portion of the economized funds on a fair and legitimate basis among operating units? Labor remuneration should be in line with quality and quantity of labor.

Development of the Tu-160 bomber does not signify (and this is also acknowledged in the West) a fundamental increase in the total number of Soviet long-range bombers. Since 1960 they have comprised the smallest component element of the Soviet strategic triad, but nevertheless, as the magazine INTERAVIA states, "put aloft upon receiving the signal that military operations have commenced, they will continue to be capable of inflicting irreparable damage and destruction on industrial centers and military installations on U.S. soil." At NATO headquarters they are counting heavily on the deployment of AWACS aircraft, F-15s, as well as F-18 fighters to counter this capability.

Today each side is keeping close watch on the other, prepared at all times to respond to a change in strategic parity. The Tu-160 is a mirror reflection of the arguments of the winged nuclear triad of the opposing military alliance. And, we might add, it is a weighty argument.

Fighter Pilot Experiences Near-Fatal Mechanical Failure

90R10007L Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 10, Oct 89 (signed to press 12 Sep 89) pp 32-33

[Article, published under the heading "Just One Incident," by Mar Avn N. Skomorokhov: "'Come Back Safe!'"]

[Text] Familiar lights appeared on the ground below, gleaming through the thick haze. Soon the field would be in sight, he would be landing, and... going home.

Lagutin pictured his wife smiling and little Svetlanka, wakening from sleep, joyously clapping her hands. But suddenly.... As he was flying the landing approach, the aircraft started to roll left. Lagutin, applying controls, attempted to stop the aircraft from rolling. Nosing up, the aircraft proceeded to shake. Airspeed was dropping off rapidly. The aircraft was only a few dozen meters above the ground!

"What are you doing? What are you doing?" Lagutin heard the hysterical voice of the flight operations officer, Maj Rebrov, in his helmet headset. "Pull up! Pull up! You're going to crash!"

Lagutin froze for an instant, trying to grasp what had happened. Glancing groundward, he noticed that the runway approach lights were coming on fast, growing in

size. The aircraft, continuing to roll slowly, shivered and relentlessly approached the ground.

"What happened?" the pilot asked himself, exerting an intense mental effort, and subconsciously aware of the fact that he had to find an answer within not more than 2 or 3 seconds. "Has a flap torn off? Is my left wing damaged? Did the right main gear not extend?"

Before he had even finished his mental analysis of possible causes of the problem, his left hand extended to the servo control lever and disengaged it, after which his right hand and left foot, also responding mechanically, coordinated movement of stick and pedals to bring the aircraft back under control. Rolling back level just before touchdown, Lagutin landed safely.

"I appear to have lucked out," he said to himself, not yet fully understanding what had happened, and leaned back in his seat, holding the aircraft straight on the runway.

Events took place so swiftly that all actions, from the moment the emergency situation occurred until the aircraft was back in a normal attitude, took not more than 6 seconds. During this time his brain analyzed approximately 10 different possible reasons why the aircraft had begun to roll. Instant response to the aircraft's behavior in the air, developed through years of practical flying, had averted tragedy.

Lagutin taxied to the ramp and released his canopy, but he continued sitting in the cockpit as he regained his composure. One question in his mind was relentless: "Just what had happened?" He could feel his heartbeat returning to normal. He thought to himself: "Those few seconds were a real ordeal!"

At that point Lagutin could not know that on the following day a specially formed panel would determine what had caused the aircraft to roll. It was determined that a tiny bit of foreign matter had gotten under a hydraulic control valve, as a result of which the servo control unit had malfunctioned. But this would not be determined until tomorrow. Lagutin wanted to get to the heart of the matter right now, today.

Mentally going through his actions during the entire flight, he concluded that he had done everything correctly. In addition, he became more convinced than ever that it had been worthwhile practicing for years, honing every control movement to a state of automatism, just for the sake of that instant response to the emergency.

Of course it is no big thing for a fighter pilot to roll his aircraft inverted. How many rolls had he executed in his career? Thousands! But that was when the aircraft was rolling in response to the pilot! But if this happened due to a malfunction, within just a few seconds the question of the life or death of the pilot is decided, as well as destruction of a modern aircraft, which had cost the people a great deal of money.

The flight operations officer sped up to the aircraft in a Gazik [Soviet jeep-type vehicle], breaking into Lagutin's thoughts. He jumped out of the vehicle and, without waiting for the pilot to climb out of the cockpit, shouted up emotionally: "How did you do it?! How were you able to recover?"

The duty engineer, who had ridden up in the jeep with Rebrov, silently strode up behind him. The major, calming down a bit, continued, somewhat embarrassed: "Forgive me, general. I was so frightened for you that I forgot all about military etiquette."

"No problem," Lagutin reassured him. "The main thing is that it all ended safely."

...In his more than 20 years of flying fighter aircraft, Lagutin had experienced many in-flight emergency situations when, just like today, the correct and only correct decision had to be made within seconds. He had long since become thoroughly familiar with the specific features of the fighter pilot profession, he had thoroughly studied and mastered the most critical elements of flying, and at times he felt calmer before sortie departure than when entering the office of some of his superiors.

This might seem strange to some people, but no matter how dangerous various in-flight emergency situations are, a pilot becomes accustomed to them, and when they suddenly occur during flight, his mind and will are totally concentrated on overcoming the danger. It is probably precisely this which helps the pilot reach within seconds the only correct decision, helps him emerge victorious and helps avert a tragic outcome. Pilots know this and prepare in advance, discussing at their critique and analysis sessions all kinds of in-flight emergency situations and determining the necessary response actions.

As he continued the conversation with the flight operations officer and the duty engineer, Lagutin said to himself: "I hope my family doesn't learn about this. I hope none of the boys lets it slip.... Then things will really begin: trials and tribulations...." He recalled how long Svetlanka had stayed at the window waving as he had left for the airfield.

After taking off his flight gear, Lagutin leisurely headed homeward, enjoying the coolness of the evening. Following old habit, he walked along a well-worn path, his way illuminated by infrequent lights along the path. On this occasion he was walking more slowly than usual. He wanted to recover his composure fully, so that his wife would not notice on his face signs of his recent trying experience.

He entered the front door. As usual, his wife was waiting up for him. His daughter, sprawled on the sofa, was smiling in her sleep. Lagutin gazed over at her, walked over to the sofa, bent down and kissed her on the cheek. The little girl wrapped her arms around his neck, whispering something in her sleep. He gently released her grasp and adjusted the covers.

"What happened, Vitya?" his wife asked, a note of concern in her voice.

"Nothing, everything's fine."

"No, she insisted. "I can tell that something has happened...."

"Nothing really," Lagutin replied evasively, averting his eyes.

Stealing a glance in Irina's direction, Lagutin could clearly see anxiety in her eyes. Pilots' wives experience a great deal of anxiety! What thoughts go through their mind when their husbands are out flying! Sometimes a husband is barely out the door when his wife starts giving way to thoughts and imagination. But the thoughts are always somber. She is thinking about only one thing, hoping that nothing happens and that her husband will return safe and sound.

The most joyous melody for pilots' wives is the roar of aircraft engines. If these sounds fill the air around the airfield, this means that everything is fine. Day and night they listen to this reassuring melody, in their thoughts accompanying their husbands into the wild blue yonder. They wait with palpitating heart until they hear that long-awaited ringing of the doorbell....

New Volume of Military-Interest Fiction

90R10007M Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 10, Oct 89 (signed to press 12 Sep 89) p 33

[Book review, published under the heading "New Books": "Limits of the Possible"]

[Text] The tactical air exercise was presenting difficulties for the squadron under the command of Maj F. Yefimov. But the pilots were successfully accomplishing the assigned mission. The final, decisive phase of the air exercise remained. Yefimov would be making a drone intercept out at sea. They knew that the target would be trying to penetrate through to the airbase at all costs, but the deputy commander in chief of the Air Force had prepared a little surprise for the interceptor pilot....

The squadron commander made fairly short work of the drone and was about to report his kill back to the command post, but first he did an airspace scan by habit. He spotted a second drone heading swiftly in his direction, but at a lower altitude. So this was the surprise! While the pilot was playing cat and mouse with the first drone, the other one, taking concealment against the high shore, was approaching the target. If the "threat" reached the airfield and succeeded in delivering a strike, all preceding efforts would be nullified.

Major Yefimov headed off again to the attack. Keeping his eyes on the target, for a short time he stopped monitoring his instruments. When he finally glanced at the altimeter, he realized that he was below the minimum altitude. He had been warned not to descend below 1,000 meters, because there was active bird migration in progress at altitudes up to 800 meters. But he had brought his aircraft to level flight considerably below that altitude.

He could of course climb to a safe altitude, but then he would be unable to bring his weapons to bear on the target. He then made a decision: he switched the armament selector to cannon fire, carefully "pulled" the drone into his gunsight, and squeezed the button. He then immediately proceeded to climb. But he was too late. He heard a dull thump, a cracking sound, and felt the aircraft vibrating. The situation was rapidly deteriorating. The pilot pulled hard on the ejection handles....

This is one of the incidents in A. Pichuk's novella "Bitter Aroma of Spring" (Pinchuk, A. F., "Gorkiy zapakh vesny: Povesti i rasskazy" [Bitter Aroma of Spring: Novellas and Short Stories], Moscow, Voyenizdat, 1989, 368 pages, price 1 ruble 60 kopecks). The author has succeeded in following the life of the main hero through a comparatively brief segment of time, in revealing his inner world, and in showing the thoughts and feelings of a person faced with a difficult moral choice. Yefimov understands that the loss of an aircraft is a blow by fate against him as well, as a pilot and as a commander. He understands that he will no longer be able to fly. But he does not betray his officer's honor and conscience.

Perhaps another person in his place would attempt to conceal the actual circumstances connected with the loss of the aircraft, particularly since very attractive career prospects are opening up for him. There are those who, protecting the honor of the uniform, at times suggest that he remain silent. When, they argue, will they be able to raise the aircraft from the bottom of the sea and examine its "black box"? But Yefimov is unable to strike a deal with his conscience. His ensuing fate is less than ideal. But nevertheless the squadron commander, in spite of his fall from grace, is able to raise himself up, making use of a presented opportunity. He becomes a novice helicopter pilot. In a short period of time, having displayed a great deal of persistence and stick-to-itiveness, he masters this new aircraft and becomes a top-notch aircraft commander.

This is followed by the perilous skies of Afghanistan and an operation to extract wounded soldiers and recover a crippled helicopter....

In this novella, written in a vivid and emotional manner, one senses the pulsebeat of life; the life of the military aviator is shown as it actually is, without embellishment. The characters of the heroes and the interweaving of their fates are depicted in a clear and tangible manner. Elements present include reflections about duty and examination of the problem of the relationship between flight personnel training and that which will be demanded by modern combat.

The novellas "Noisy Celebration" and "Khiromant Sukhov" hold the reader's interest just as tightly. The former is about young boys who later become cadets at a higher military school for pilots. One of them, Timur Kotin, performs a courageous deed, shielding with his own body an officer who had dropped a hand grenade while instructing cadets in a field training class. The latter deals with the fate of two friends, naval officers and inventor enthusiasts, and describes the difficulties which these innovators experience.

The stories in this volume: "Everything Is Just Beginning," "Soldier's Fare," "White Nights," "Bitter Aroma of Spring" and others—meet the demanding tastes of the military reader. On the whole this book compels one to give thought to the prestige of military service, to duty and nobility, and to how one can know what one is capable of achieving and to strive toward that level of achievement.

Predicting Engine Failure by Monitoring Vibration Level

90R10007N Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 10, Oct 89 (signed to press 12 Sep 89) pp 34-35

[Article, published under the heading "Innovations in Aircraft Maintenance," by Lt Col Yu. Kuzmin, candidate of technical sciences; Maj V. Zhdanov; and Maj L. Burtsev, Air Force regiment aircraft maintenance unit chief: "Method of Determining Pre-Failure State"]

[Text] A critically important period for the unit's aviation engineer service commenced when the unit was bringing the heavy-lifter Ruslans [Antonov An-124 Condor heavy-lift transport aircraft] into operational service. Sr Lts V. Polyanskiy and N. Olshanov and WOs A. Tripuzov and A. Levkin contributed a great deal of effort and labor to the common cause. These airmen are distinguished by innovative inquiry and an endeavor to master the new equipment to perfection. "When an aircraft is prepared for flight by such highly-skilled, conscientious maintenance people, you feel calmer and more confident in the air," comment aircrew members.

Initial experience in operating the An-124 indicated that, as in the past, performance of technical procedures pertaining to routine servicing and maintenance of airframes and powerplants, rigorously prescribed in terms of scope and timetable, as well as prompt and timely performance of routine scheduled maintenance and preventive maintenance procedures pertaining to detecting, correcting, and preventing malfunctions and physical damage constitute a guarantee of mishap-free operations. At the same time, and this point has not escaped the attention of unit aviation engineer service supervisors, the effectiveness of these activities depends on employed methods of inspection, monitoring and verification to a greater extent than in the past. We shall examine this question in greater detail.

Recently various testing and diagnostics systems based on ground and onboard computers have been used more and more frequently to detect and predict damage and malfunctions which occur in the course of equipment operation. Computers provide flight and engineer-technician personnel with prompt and timely information on the state and condition of the systems and components being monitored or inspected, including determination of the exact location of malfunctions and the forming of data for purpose of decision-making on procedure of subsequent operation and maintenance. At the same time there is constant and continuous monitoring of the parameters of a given unit or component in specified operating modes and conditions, utilizing standard monitoring or test (or display) devices, as well as periodic monitoring to determine correctness of operation and state of working order, utilizing standard indicator and warning devices, as well as specific monitoring of a system or component in order to detect specific types of deviations in operation, utilizing standard onboard indicator and emergency warning devices.

The facilities and equipment for diagnostic testing unquestionably match the level of development of modern aircraft. Unfortunately, however, the methodological aspect of processing results is lagging considerably behind. In order to demonstrate this fact, we shall examine methods of indirect evaluation of the state and condition of a monitored item (fixed-wing or rotary-wing aircraft system, assembly, component) which are the most widely used at the present time, methods based on analysis of changes in values indicating vibration level. This is a very important parameter. The fact is that many malfunctions and abnormalities in engine operation alter the nature of emitted vibrational and acoustic signals. Analysis of their components is an effective means of determining technical state and condition. The level of vibration of the compressor or turbine housing is a determined standard quantity. Analysis of this parameter under operating conditions provides capability promptly to detect such typical malfunctions and problems as mechanical failure of compressor or turbine blades, bearing failure, etc.

The tolerance method is the most widely used today, whereby the measured actual vibration value is not to exceed a standard amount. Comparison is made on the basis of instrument readings, warning devices, and analysis of flight data recorder tapes.

Another method is based on limiting the amount of change in vibration value (increase or decrease). When an engine is installed on an aircraft, an initial value is calculated as an arithmetic mean obtained from five (the number is determined individually for each type of aircraft) measurements performed during the initial hours of engine operation. This initial value is compared with the value obtained during engine static testing at the factory (entered in the engine maintenance log). If the difference exceeds predetermined value ΔV mm/s, the cause must be determined and the problem corrected. In the course of subsequent operation change in vibration value is allowable by an amount not exceeding ΔV_1 mm/s (allowable change during engine service life).

There is also another method, similar to the above-described principle, whereby magnitude of change in vibration value is monitored and limited, but in relation to a base and a reference value. The base value is determined as the arithmetic mean of the first five (in conformity with performance requirements for the specific type of aircraft) flights and remains unchanged during subsequent engine operation. The reference value is the arithmetic mean for the last 50 (also individually for each aircraft) flights. One analyzes the difference between measured vibration values during a given flight and the base value, as well as between average data for the last five flights, including the current flight, and the calculated reference value.

With the devised new method it is proposed to compare not individual vibration values but rather the rate of change in these values. This will make it possible more reliably to estimate the technical state of systems and components (in contrast to previously used methods), right up to the onset of threshold (allowable) parameter values, and therefore to predict possible malfunctions and equipment failure in a more effective manner. Figure 1 shows results of runup to maximum power on an engine removed from service prior to completing standard service life in connection with an increased vibration level at above 95 percent maximum rpm and exceeding maximum vibration amplitude. (Engine disassembly revealed failure of two bolts securing the labyrinth packing to the final-stage compressor disk.) This diagram also shows the timeline trend in vibration values, obtained by the running mean method. Smoothed vibration values were used to calculate the absolute rate of change in vibration level with the formula

$$V_{\text{изм}} = \frac{\Delta V}{\Delta t}$$

and relative rate, using formula $\overline{V}_{\text{изм}} = \frac{V_{\text{изм}}}{V_{\text{уст}}}$ (ΔV -- change in

vibration level at engine operating time interval Δt_i; t -- total accrued engine time; $V_{уст}$ -- steady-state value of vibration incremental increase). The following has been established by investigations of the patterns of change in values of the monitored parameters which reflect the processes of development of malfunctions of actual technical systems: if $\nabla > 2...3$, then the system in question is capable of continuing to operate. It is evident from the obtained results (Figure 2) that the rate of the process of rotor going out of balance increased after 250 hours of operation ($\nabla_{изм} > 3$) and, in spite of the fact that with an engine runup after 261 hours (that is, 46 hours prior to indication of failure) the vibration level was only 30 mm/s (according to specifications, equal to or less than 45 mm/s), one can conclude that the engine is in a state approaching failure and that more thorough monitoring must be performed, since $\nabla_{изм} \cong 7,25$.

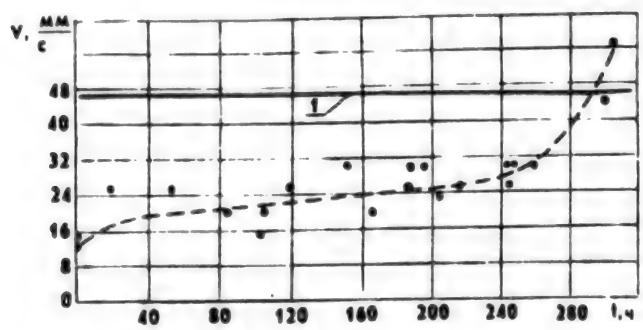


Figure 1. Change in Engine Vibration Level at Maximum Output. 1 -- maximum allowable vibration value (V). The dashed line indicates the timeline trend in vibration values.

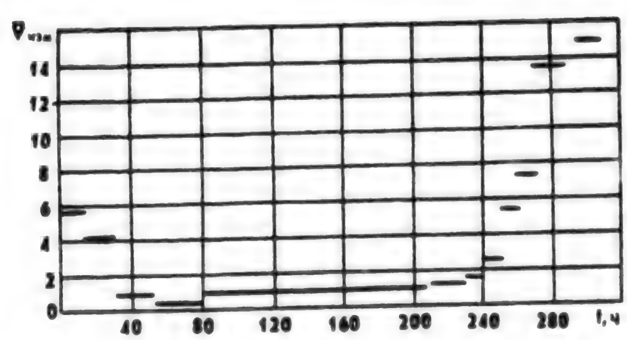


Figure 2. Value of Relative Rate of Change in Engine Vibration Level $\nabla_{изм}$ at Maximum Power.

We should note in particular that on some engines the degree of information provided by certain operating conditions may change as the engine logs more operating hours. Externally this is manifested in the fact that the vibration level growth trend under specific engine operating test conditions can reverse over an extended period of time, as if responding to a different but proximate rotor rpm, or it can disappear entirely. On these engines, and in case of reestablishment of a vibration values growth trend in one of the monitored engine operating modes, one cannot always with adequate preventive effectiveness predict remaining time to failure (if it is not possible to correct in line-unit conditions the cause of vibration increase).

In connection with the above, in such instances it is recommended that one, utilizing the proposed method, estimate the amount of engine vibration value increase per unit of engine operation hours as an average value of the incremental increase in several operating test modes in which there occurs clearly-marked (primarily increasing) dynamics of vibration level values. Taking into account deviations in values V from the average by quantity $\pm\sigma$ makes it possible to gain a clearer picture of the dynamics of development of the process of vibration level change. It has been established by calculations on a specific engine that $V_{ср}$ comprises approximately $1{,}2 \cdot 10^{-2} \underline{мм/c}$, while $\nabla_{нэм} > 3$ occurs after 220 hours of engine operation.[4] During flight, with more than 240 engine hours logged, there were noted instances of brief triggering of excessive vibration warning. The obtained results attest to the possibility of increasing the effectiveness of employment of existing standard available monitoring devices with the aim of early detection of a developing malfunction by calculating values $\nabla_{нэм}$. Let us examine in somewhat more detail the essence of the proposed method and the effect of sensitivity of devices recording the monitored parameters on the prevention effectiveness of this method. The method examined above is based on the assumption that decrease in the quality of operating performance of a monitored piece of aircraft equipment which ends in failure under the effect of any of the operating loads (total hours of operation measured in corresponding units) F, takes place in three stages: 1 -- break-in stage, during which there occurs a decrease in the rate of deterioration of quality to a steady-state level ($V_{уст}$); 2 -- main stage of operating life, when the actual rate of decrease in quality of the monitored item maintains an approximately constant value $V_{уст}$; 3 -- stage of increase in rate of quality decline, reflecting the approach of transition by the monitored item from a state of good working order to an inoperative state.

A computed quantitative characteristic curve of relative rate of quality decline is introduced (Figure 3).

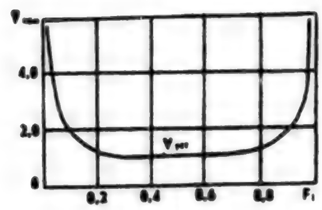


Figure 3. Characteristic Curve of Relative Rate of Decline in Quality of Component (monitored item).

One important positive property of the proposed dimensionless characteristic consists in the fact that it remains unchanged at all existing values of intensity (A) of effect perceived during the entire time of operation of magnitude of stress loading F_i. When investigating the dynamics of measured values of monitored parameters of specific systems, the characteristic curve (see Figure 3) can become flatter as a consequence of the sensing device's low sensitivity to the period of development of malfunction or as a result of averaging the results of measurements taken during several periods of considerable duration between testing. In connection with this, a validated periodicity of testing ($\Delta\tau$) should be designated, taking into account the intensity of operation in the most damaging operating modes:

$$\Delta\tau = d\frac{1}{A},$$

where d is the percentage of maximum engine service life for which value $V_{изм}$ is (or is perceived to be) actually (or on the basis of available information on measurement results) constant. Coefficient d can also serve as a characteristic of the sensitivity of the employed sensing device to the process of development of that type of failure which this sensing device is designed to detect.

It is evident from Figure 3 that the linear segment on which the relative rate of quality deterioration is constant ends at value $F_i \cong 0,7$, after which the rate increases rapidly to a value of 2...3, after which it rises even more rapidly. Thus an increase in the relative rate of 2...3 times reflects approach to failure. If the sensitivity of the sensing device is not known, it is advisable to increase to 1.5...6 the range of threshold rate at which it is necessary to make a detailed investigation of the technical state of the monitored item.

The calculation algorithm has been written in the form of a computer program but, as the example shows, it can also be used manually for simple calculations of quantitative estimate of degree of proximity of the mechanical condition of an airplane (helicopter) system, assembly, component, or part to failure.

Practical experience indicates that utilization of this new testing method increases effectiveness of utilization of aircraft systems, ensuring reliability and flight safety.

Mother Grieves For Son Killed in Afghanistan

90R10007O Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 10, Oct 89 (signed to press 12 Sep 89) pp 36-37

[Article, published under the heading "We Are Internationalists," by Capt V. Sklyar: "Street of Her Older Son"]

[Text] He had lived on the street which now bears his name. A person of direct and uncompromising nature, one of those people who say what they think. And at the same time he was extremely kind and responsive. Gds Lt Aleksandr Rezayev died exactly one month before his 25th birthday. His transport aircraft, carrying a load of medical and food supplies for the Afghan civilian population, was downed by a mujahideen missile in the skies over Shindand.

His mother swears that her son's soul came to her that day at midnight.

"Mom, mom!" Sasha had called and had softly rapped at the window.

"What is it, son?" Zoya Mikhaylovna awakened and sat up on the edge of the bed. Her heart was beating so hard that it seemed to be about to explode.

"Mother...," she once again heard a barely audible sigh outside the window.

She turned on the light in the front hall and on the porch. She hurriedly opened the door and ran out onto the porch. There was nobody there! The warm, humid September night clasped her in a sticky spiderweb embrace. She crossed the garden barefoot, touching the trunks of the apple trees. She walked back into the house and sat down by a small icon. She was assailed by intensifying waves of troubling thoughts.

"My Sashenka was calling me. He is in pain. I have this feeling something bad has happened...." Zoya Mikhaylovna gazed in perplexity at her alarmed husband. "Go back to sleep, Yura, you are on first shift tomorrow. I'm going to stay up a while...."

She remained awake the rest of the night. She dozed off toward morning. She awakened from troubled sleep. The mailman was knocking at the gate. She silently unfolded the telegram. "It is with the deepest regret that I inform you that your son, Aleksandr Yuryevich Rezayev, died a hero's death on 16 September 1983 during the performance of duty. Unit commanding officer." At first she was unable to grasp the meaning of the briefly-worded telegram. No! No! No!

Death is always monstrously unfair. But it is particularly blasphemous when parents are forced to bury their children in whom they saw their own hopes, their own conscience, the fruit of their joys and sorrows.

I shall endeavor from the accounts of those close to him, from letters and documents, to recreate the image of a person, my contemporary and fellow Afghanistan veteran, whom I never met. Our paths never crossed in that war to which both of us were called.

It was the day of the burial. In three weeks he would have celebrated his 25th birthday. Sasha's former classmates brought exactly 25 red carnations to his grave. They stood silently for some time, recalling school days and their irrepressible Komsomol organizer.

...People sometimes call total commitment to a dream obstinacy. In the eighth grade, during PE, the teacher nodded indulgently toward the other boys, pointing to Sasha: "This kid is really weak." You can imagine what a blow this was to his self-esteem! For a time Rezayev abandoned even his favorite activity, building model airplanes, and began going off somewhere in the evenings. Once his friends saw him on the canal, in a kayak. He was frenziedly paddling against the current on a stretch of swift water near the power station. He paddled to the point of physical exhaustion. This was followed by DOSAAF, parachute jumping, the "celestial slowpoke"—the An-2, and his first intoxicating encounters with the heavens.

"Where are you applying to?" he was asked at the military commissariat as he submitted the documents.

"To 'Balashikha'!" he replied with a smile.

For two years in a row Aleksandr tried to make his dream come true. Unfortunately, however, the competitive examinations presented an insurmountable obstacle. The school's commanding officer, Maj Gen Avn N. Vertel, said to this secondary school graduate as he was leaving: "You are persistent! We like people like that. Unless you change your mind, come back again. I personally will do what I can for you."

When Rezayev arrived home, a draft notice was waiting for him. After completing junior aircraft maintenance specialist school, he was stationed in Mongolia. He submitted a formal request for enrollment at the Balashov School. This time he was accepted.

I leafed through a graduating class yearbook for the Balashov Higher Military Aviation School for Pilots. I had no trouble spotting Sasha among his classmates. He was always at the center—the heart of the group. In some pictures he looks shy, while more frequently he looks cheerful and carefree—a sign of happiness engendered by the fact that one has found one's place in life. In one photograph he is about to climb into an airplane cockpit, while in another picture a general is shaking his hand: he

had conducted himself in a courageous manner during an in-flight emergency while flying in a two-seater trainer.

"Shurka! I wish you the best. May you fly your entire life! Viktor." This is one of the many inscriptions one finds in the yearbook.

Zoya Mikhaylovna related that on the day he died her son had gotten together in Kabul with a classmate by the name of Viktor, who had returned with his crew from the airfield to which Rezayev was going to be flying. The officers spent several hours together. Prior to Sasha's departure they had even had time to go to a shop and buy him a leather jacket with a great many zippered pockets of various size. He filled these pockets with presents for his parents and brothers. He knew how much they were looking forward to seeing him.

Prior to this time he had come home to the Soviet Union from Afghanistan for several days, as part of a flight assignment. He could not pass up the opportunity to attend the wedding of Volodya, his middle brother.

"Well, my little brother beat me to it," Sasha joked. "No problem. Soon we will be celebrating my own marriage. Get ready, mom!"

He was not joking. He and Marinka, his fiancee, had decided to take the plunge. Her heart was fairly bursting with happiness.

...On that day the shimmering mirage over the sun-scorched runway had dissipated. Dusk was falling. Bales of clothing, several tons of flour, and medical supplies were quickly transferred from KamAZ trucks into the cargo hold. The aircraft commander, Guards Captain Matytsin, adjusted his throat microphone with a practiced movement.

They were by now accustomed to the Afghan skies, in the sense that danger always lurked there. Mountain-version antiaircraft guns and heavy machineguns awaited Soviet pilots on the high slopes of the Hindu Kush, the peaks of which were jutting into the clouds. Pilots in time would intuitively take a closer look at any glints and flashes of light on the ground. Subsequently aircraft began to be equipped with heat flares, which would be released during climbout and approach descent, streaming out behind an aircraft, on both sides; escort helicopter gunships also later began to be used. But at the time all a pilot had to count on was his experience, skill, and intuition.

Sasha and his fellow crewmembers knew Afghanistan not only from the aeronautical charts. They frequently met the people for the sake of whom they were risking their own lives almost daily. Hunger, poverty. A great deal has been written about this. But it is one thing to read historical treatises about a feudal system and quite another thing altogether personally to place a loaf of bread into an emaciated hand. It is hardly likely that the people greeting the An-12 transports knew anything about the high-level diplomatic battle going on over this war, which subsequently was called an "undeclared" war. Their guileless peasant mind simply divided the world into good people and bad people, into those who give and those who take away.

"...We are not diplomats by calling," Sasha would sometimes sing along with a cassette recording of the Yuriy Kirsanov song which was so popular at the time. Although he was just learning to play the guitar, his comrades would listen to his singing, forgiving that false note or wrong chord. I believe it was because there was no false note in his soul.

Sasha himself had a try at writing poetry. But he did not say a word to anybody about it. The notebook containing his poetry was a total surprise even to his mother. I saw that little notebook, somewhat the worse for wear, which his comrades had sent along to Zoya Mikhaylovna together with their friend's other personal effects. He had written down quatrains by Pushkin and Asadov, Vysotskiy and Vizbor which had taken his fancy. Some people might consider that these poets are not very compatible to one another. Taken together, however, they reflected the state of his soul. Stanzas about good and honor, love and courage took on a kind of special meaning. You can't alter a person who has chosen nobility, compassion, and boldness as his ideals.

"Sasha would remember his friends' birthdays," A. Beglova, one of his classmates, told me. "He was the kind of boy whom girls would usually classify as a gentleman. He was willing to stand up for fairness and justice, no matter what the cost."

Zoya Mikhaylovna told me of her son's sensitivity. On his free days he would do chores like repairing the roof or digging in the garden. He was very fond of the apple trees, especially in the spring, when they were in snowy-white full blossom. His mother doted on him. Yes, he himself was happy and he also made others happy.

"51 ready for takeoff! ...Roger, cleared for takeoff...."

The aircraft climbed out over Kabul in a spiraling flight path and set course for Shindand. Shortly before midnight they commenced their approach descent. The first mujahideen machinegun bursts were barely audible over the roar of the engines. The transport aircraft had come into a crossfire. Bullets riddled the aircraft's skin. The mujahideen then launched a missile.

We shall never know how these men responded in their final moments. But the facts which are known as well as eyewitness testimony incontrovertibly prove that they were endeavoring to save their cargo and to reach the destination. The crew carried out its military and internationalist duty to the end.

I was not able immediately to bring myself to meet with the Rezayev family. Zoya Mikhaylovna and Yuriy Baymetovich raised eight sons. Six of them are no longer with us. Why is life sometimes so unfair?

A few words, incidentally, about concern for the families of those killed in action in Afghanistan. On the day of my arrival in the community of Tavaksay, in Bostanlykskiy

Rayon, Tashkent Oblast, where the Rezayevs reside, Zoya Mikhaylovna was forced to spend a considerable amount of time at the military commissariat, trying to find out why her name was not on the list of those entitled to receive a food ration allowance. The short-supply items were gone by the time it was determined that due to somebody's carelessness they had simply forgotten to add her name to the list.

Is it worth it to bring this subject up? I think it is, for we are dealing here with our attitude toward military personnel killed in action, toward their parents and families, and with social justice.

After Aleksandr's death, his younger brother Aleksey made a firm decision to become an officer. He wanted very much to enroll in a Suvorov school. But he is presently attending ninth grade in a regular school. A question naturally arises: what kept him from entering a Suvorov school? They say that it was a birthmark. It is not my intention to question the competence of the medical board which examined the applicants, but in my opinion the matter could have been settled differently if they had taken into consideration the circumstances under the effect of which this lad made his career choice.

I visited the grave of Aleksandr Rezayev. The following dates are inscribed on the red marble headstone, under his portrait: "17 October 1958-16 September 1983." An aircraft in flight is portrayed just below these dates, with the inscription: "Killed during the performance of duty." I asked a woman who happened to be standing nearby: "Do you know what happened to him?" She did know, just as everybody in the community knew, that the remains of an Afghanistan veteran were buried here. Other boys killed in action are also buried in that cemetery. The fact that they are not buried side by side is intentional, in order not to create "incorrect" attitudes, as the rayon officials saw it.

How many years now they have been teaching us what kind of an attitude and understanding of realities we should have! Perhaps this is why the mothers and wives of boys killed in action in Afghanistan must run from one government office to another, fighting for their right to benefits. I am not advocating handouts—what I am urging is compassion and humanity!

War Veteran Discusses High Wartime Aircraft Accident Figures

90R10007P Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 10, Oct 89 (signed to press 12 Sep 89) pp 38-39

[Article, published under the heading "Flight Safety: Experience, Analysis, Problems," by twice Hero of the Soviet Union Maj Gen Avn (Ret) G. Sivkov, candidate of technical sciences: "Could There Have Been Fewer Losses?"; part one of two-part article]

[Text] **Twice Hero of the Soviet Union Maj Gen Avn (Ret) G. Sivkov, candidate of technical sciences, reflects on prevention of air mishaps in conditions of combat operations**

* * *

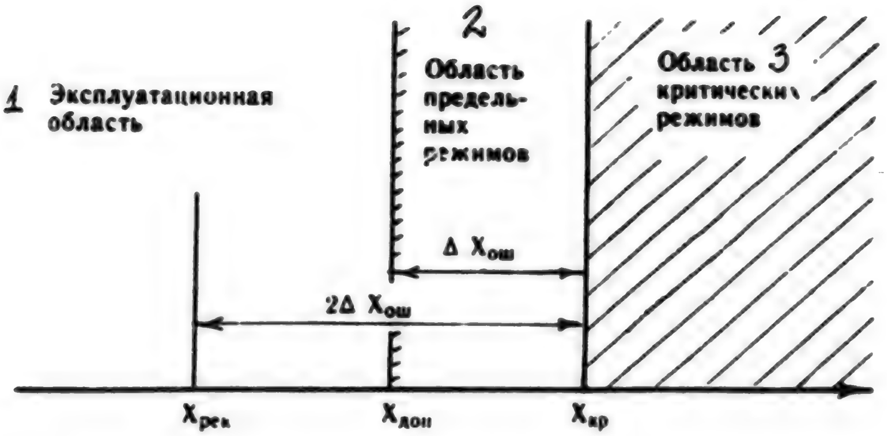
The facts of heavy combat losses of aircraft sustained in the Great Patriotic War are well known. Many people, however, are unacquainted with world statistics on aircraft accidents which have occurred in wartime without hostile fire being a factor. Relative losses due to aircraft accidents in three wars—World Wars I and II, as well as in the U.S. war in Southeast Asia—comprise approximately 50 percent of total aircraft losses. This same percentage applies to Soviet aircraft losses in the Great Patriotic War.

During World War I—the period of emergence of aviation—the enormous losses due to aircraft accidents, exceeding combat losses by a factor of three, can be ascribed to the fact of primitive hardware and lack of skill in operating it. And yet the fact that half of all aircraft losses in World War II and in the U.S. war in Southeast Asia in 1961-1972, as well as in other local wars were due to aircraft accidents can hardly be ascribed solely to inadequacies of design and construction and insufficient pilot skill. Obviously there are other factors involved as well. And if one considers the fact that the percentage of aircraft involved in accidents is showing a rising trend in present-day local wars, there are more than enough reasons for concern.

Is it indeed not a serious matter that in World War II, that most deadly of wars, the death totals from which continue to boggle the mind, the total number of aircraft losses from accidents is commensurate with combat losses? If one gives serious thought to this question, one can understand what an important task elaboration and implementation of effective measures to prevent mishaps and fatal accidents in conditions of conduct of combat operations constitute both for military aviators and for those who design and build combat hardware.

Let us say that as a result of special measures which have been adopted we have succeeded in avoiding at least half of all air mishaps. This means reversing the loss of 25 percent of aviators' lives and costly equipment. In addition, preventing one half of all air accidents is equivalent to obtaining, almost without additional expenditure of material and manpower resources, a 25 percent increase in production from existing aircraft industry facilities in conditions of wartime, when every kopeck counts! There would be a substantial increase in the overall combat effectiveness of our aircraft fleet, and we would be able much more fully to implement its enormous reserve potential.

Figures characterizing changes in the level of flight safety when shifting from peacetime training to actual combat operations are even more impressive. The results of conducted studies indicate that the average number of hours flown per air accident not involving hostile action in the initial period of the Great Patriotic War and in present-day local wars decreased by a factor of five to six. The level of risk that pilots would not return from a flight even if they did not encounter the enemy increased by approximately an equal amount.



Key:
1. Operating envelope.
2. Region of maximum conditions.
3. Region of critical conditions

What are the reasons for such a substantial increase in probability of air accidents when shifting to conduct of combat operations? Before attempting to answer this question, we shall examine the principal differences in conditions of combat operations from conditions of peacetime aircrew training.

A fundamental feature of combat operations is an endeavor on the part of the opposing forces to destroy one another. The threat of death and destruction inevitably leads to mobilization of all the capabilities of the opposing sides to attain victory. This law of combat compels pilots, when performing missions, to utilize flight conditions which are close to critical, whereby at least one parameter exceeds critical value X_{kp}.

We should recall that a critical flight parameter value is one whereby irreversible changes in the aircraft's performance characteristics or in its flight dynamics are possible when this value is exceeded. For example, an angle of attack at which an aircraft stalls and loss of stability or controllability occurs; a load factor at which residual deformations of structural load-bearing elements occur; dynamic pressure at which breakdown of local structural strength or flutter occur.

When flying in conditions close to critical, there is a sharp increase in probability of entering critical conditions and, consequently, of air mishaps. In order to prevent this it is necessary first of all to have a good sense in the air of the aircraft's behavior when approaching critical conditions (thoroughly mastering flight in proximity to such conditions); second, one must substantially increase one's flying precision, in order to approach hazardous conditions as closely and as safely as possible without exceeding them, thus maximally utilizing the aircraft's performance capabilities.

During the war I took part repeatedly in air-to-air engagements with fascist fighters at extremely low altitudes, when it was necessary to execute steep turns at a height of 10-15 meters above the ground. As we know, exceptionally high precision in flying is required in order to maintain constant and extremely low altitude with an accuracy of plus or minus a few meters when executing a steep turn. Otherwise there is a sharply increased probability of mishap or fatal accident. But while such actions are objectively necessary in combat, attempts to perform such a maneuver in peacetime conditions are subject to severe punishment as exceptionally dangerous and harmful actions.

In contrast to combat conditions, in peacetime, when there is no actual combat confrontation with an adversary, there is no need to approach to the edge of critical conditions. On the contrary, in order to lessen risk, maximum allowable flight parameter values X_{all} are established, which are less than critical values X_{kp} by amount of possible deviation X_{ot} as a consequence of possible natural piloting errors (see diagram). A pilot is severely punished for exceeding specified restrictions. Therefore in order to make sure that they do not commit unintentional violations, pilots hold an additional X_{ot} short of these values, consequently holding short of critical flight conditions by double the amount of allowable error 2 X_{ot}.

Considering that allowable deviations are determined on the basis of peacetime statistical data, one can state the following: in the interests of lessening risk, the performance capabilities of fixed-wing and rotary-wing aircraft are not fully utilized in routine operations. It follows from this that the objective requirements on training flight personnel in conditions of combat operations and peacetime differ sharply. Of primary importance in actual combat is the objective need for practical mastery of flight conditions which are extremely close to critical, while this is absolutely prohibited during training. In addition, the objective purpose of operating restrictions in peacetime conditions is to ensure against exceeding critical flight parameter values in order to increase flight safety, while in combat conditions approaching critical

flight conditions is dictated by the need to achieve maximally advantageous conditions for victory over the adversary, with simultaneous attainment of absolute precision in flying, which ensures flight safety. As we see, practical necessities force one to establish operating restrictions X_{all} which are much closer to X_{kp} during a period of combat operations.

It follows from the above that the objective tasks of flight training also sharply differ between wartime and peacetime. Predominant in conditions of war is the endeavor to defeat the adversary by means of sure mastery of flight conditions close to critical and maximally increasing flying precision to the highest possible degree, and attainment of a high level of all other types of flight training. For example, flying in instrument meteorological conditions and at night, navigation training and detailed position reference, full achievement of takeoff and landing performance capabilities on concrete runway, dirt or grass strip, etc. Failure to meet these requirements leads to a sharp increase in losses both from hostile fire and from air accidents. Other tasks are stressed in peacetime conditions: performance of scheduled combat training program activities with high marks and attainment of a specified level of proficiency, on schedule and without air mishaps. Failure to achieve these conditions does not put men's lives in jeopardy. Experience of combat operations indicates that in peacetime it is as a rule not possible to achieve a level of flight personnel training which would make it possible, when shifting to combat operations, not to have an increase in number of aircraft accidents.

I graduated from military pilot school just prior to the beginning of the Great Patriotic War. The training curriculum had been reduced from two years to 10 months. Naturally flying in instrument meteorological conditions, night flying, and flying at maximum performance conditions were out of the question. On the battlefront, however, it became necessary to do that for which I was not prepared. I made two landings at night and more than six landings in instrument meteorological conditions, at weather minimums. Time and again I flew at critical angles of attack and flew below minimum allowable height above ground level. On four occasions I took off from a dirt surface which was unsuited for takeoff, and on three occasions with indication of dangerous malfunctions and incorrect procedures during takeoff roll (turning elevator trim control in the wrong direction, with reduced engine power).

Five out of 12 forced landings during the war were due to battle damage, while seven had nothing to do with enemy action (three were due to weather and airfield conditions, two were caused by equipment failure, one was due to fuel exhaustion, and one was due to delay in receiving information).

In my opinion not only shortening of the training program was the reason for discrepancy between the level of pilot training proficiency and the actually required level in conditions of war. Frequently circumstances would require aircrews to perform tasks which were almost beyond their capabilities. These included emergency withdrawal of the regiment from under enemy attack, unscheduled close air support of amphibious assault troops in a critical situation, etc.

Take, for example, air support of the amphibious landing on the Kerch Peninsula in 1943. Our pilots had to fly at extremely low level in adverse weather and had to take off from a muddy airstrip, with the danger of nosing over into the bay. And in 1944, during the autumn flooding on the Danube, we had to take off from an unpaved strip covered with 30-40 centimeters of water.

Of course working with these kinds of conditions was out of the question during scheduled peacetime training. And yet a similar picture is observed in present-day local wars. In this case as well, it is also believed that the main reason for the large number of aircraft accidents is an inadequate level of flight personnel proficiency. The experience of modern-day combat operations indicates that pilots acquire the requisite proficiency comparatively rapidly, but this is paid for with the lives and blood of combat pilots.

One might ask why it is that under present-day conditions, in spite of a fairly long course of training at flight schools, plus an even longer period of combat training in line units, flight personnel still end up insufficiently trained and prepared?

In my opinion the main reason for this is the sharp difference in objective tasks involved in the training, as discussed above. One must be clearly aware of this fact. It is essential to counter these objective factors in advance with conscious actions to prevent aircraft accidents. How this is to be accomplished will be discussed in the concluding part of this article. **(To be concluded)**

Soviet Orbital Vehicle Telemetry and Communications Relay Ships

90R10007Q Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 10, Oct 89 (signed to press 12 Sep 89) pp 40-41

[Article, published under the heading "Space Flight Support," by V. Berdnichenko: "During 'Deaf' Revolutions"]

[Text] The above is what they call orbital vehicle revolutions during which there is no communication with ground control and telemetry facilities. Between five and six orbital revolutions occur every 24 hours, and if one considers the fact that ultrashort waves propagate in a straight line, the total period of communications loss may amount to as much as nine hours. One can easily understand that these occur above the World Ocean. Satellite service ships help eliminate such "dead spots."

The main difference between shipboard and land telemetry monitoring facilities consists in the capability of the former to change their geographic position. Calculations show that two shipboard telemetry monitoring stations located at specific points in the Atlantic Ocean can eliminate "dead spots."

To understand the essence of the problems under consideration, we shall take a brief excursion into theory of space flight. If it were not for the rotation of the Earth and the disturbances caused by its shape and atmosphere, by the sun and other planets in a vehicle's orbital path, its track—the trace of an orbiting satellite on the surface of our planet—would always remain constant. But the earth rotates, and this causes the satellite track to displace with each revolution.

How do specialists determine this displacement? Accurate solution to the problem is possible only with the assistance of a computer. But elementary calculations are adequate for making an estimate.

Since the earth's rotational velocity on its axis is 15 degrees per hour, one can easily determine track displacement per revolution. If a satellite's orbital period is 90 minutes, the starting point of each successive revolution will displace westward 22.5 degrees, or approximately 2,500 kilometers (one degree is equal to 111 kilometers at the equator). The number of kilometers corresponding to a degree decreases as latitude increases.

The shape of the track is determined primarily by the satellite's orbital period, the earth's rotational velocity, and the inclination of the orbital plane. The orbital period introduces perhaps the greatest diversity into the track configuration. The orbital track describes a sine curve for most low-flying satellites traveling in a northeasterly or southeasterly direction. The shape of the track changes continuously with an increase in altitude. Compressing like a spring, upon reaching a 24-hour orbital period it becomes a figure 8. With a further increase in orbital period, the shape of the track in the general case is not described by familiar geometric figures. This means that the higher a satellite flies, the greater is the role played by the earth's rotation in the configuration of the orbital path.

The shape of the orbital path depends to a considerable degree not only on the orbital period but also on the inclination of the orbital plane. When traveling from east to west (inclination greater than 90 degrees), for example, the character of a satellite's track changes to such a degree that it is not possible to obtain sine-curve tracks. As the angle of inclination decreases, the abovementioned figure 8 gradually narrows and contracts to a point at zero. In this case it is said that the satellite is in a geostationary orbit.

One of the most important conditions for communicating with a satellite is its line-of-sight from the earth's surface. But how can one estimate how long radio facilities maintain communication with a satellite?

A great many people have probably seen satellites appearing as small bright stars against the night sky. Radio-frequency devices "see" better than humans, but their capabilities extend only to the horizon. For example, in a circular orbit at an altitude of approximately 300-350 kilometers, a satellite does not remain within radio communications line-of-sight more than 8-10 minutes, or more than 4.5 hours with an altitude of 20,000 kilometers. The higher a satellite is above the planet, the larger the radio communications line-of-sight zone for any given point on earth.

Now we shall take a look at the operations of space command, control and telemetry system facilities, using as an example control of the Mir space station and the Buran space shuttle. Ground telemetry facilities can maintain radio communications with the Mir space station on only nine of its 16 orbital revolutions every 24 hours, from the first to the sixth and from the 13th to the 16th revolution inclusive. From the seventh through the 12th revolution the satellite paths lie beyond radio communications line-of-sight of ground facilities. In view of the fact that orbital revolutions out of line-of-sight from ground telemetry facilities follow one after the other, for a period of approximately nine hours Mission Control would be unable to conduct radio communications with the Mir space station.

In addition, such critical operations as docking with the space station by spacecraft carrying personnel and supplies, EVAs, and descent from orbit take place in part beyond radio communications line-of-sight from ground telemetry facilities, and yet such activities require continuous monitoring. This is what predetermined the need to build and utilize telemetry monitoring ships.

Their most typical operating areas include the Northwest, Central and South Atlantic, the Mediterranean, the Central and South Pacific. Mission Control positions its ships at sea according to specific orbital communications needs. For example, the "Kosmonavt Yuriy Gagarin" or "Akademik Sergey Korolev," spelling one another every six months, are practically permanently stationed near Sable Island in the Northwestern Atlantic, for communications with the space station. They periodically make port calls in Canada, Mexico, or Cuba, approximately once every month and a half, to replenish fuel, water, and food provisions, and to provide shore leave to crew and telemetry facility personnel.

Navigation is hazardous in the Atlantic Ocean near Sable Island. Fogs and gale-force winds are frequent. But a space vehicle can be controlled precisely from this area on those orbital revolutions which are beyond radio communications line-of-sight from land control and telemetry facilities. The radio facilities aboard the satellite communications and telemetry ships operate in the same modes as counterpart facilities of the land-based telemetry system. In other parts of the Atlantic and the Mediterranean, space service vessels are deployed in a line along the track of the day's second revolution in such a manner that the line-of-sight of the shipboard

radio facilities partially overlaps. As a rule spacecraft carrying personnel and supplies dock with the Mir space station and EVA activities take place precisely during these revolutions. In addition, such a deployment also makes it possible to monitor descent from orbit by manned spacecraft, which as a rule takes place on these revolutions.

Ships of the "Kosmonavt Vladislav Volkov" class stand duty practically year-round in the Central and South Atlantic, while a ship like the "Akademik Sergey Korolev" maintains station in the Mediterranean. Their radio facilities form a zone of continuous spacecraft communications, merging with the communications zone of land telemetry facilities. During a mission these ships provide spacecraft telemetric monitoring and provide radio communications between cosmonauts and Mission Control.

We should note that total radio communications time between the ground control and telemetry system, for example, and the Mir space station runs approximately 24 minutes on the day's second orbital revolution. This time is virtually doubled by deploying three ships in the Atlantic and Mediterranean.

But how is the process of docking supply craft and manned spacecraft with the space station monitored? Generally monitoring commences on the day's first revolution, as the spacecraft are passing over the South and Central Atlantic, when approach maneuvering and the docking approach to the space station is being completed. In these areas monitoring is performed by space service vessels deployed along the flight path. Docking contact and hard docking with the space station take place within radio communications line-of-sight of land control and telemetry facilities during the day's second orbital revolution. This revolution commences at the point of intersection with the equator by the end of the path of the day's first orbital revolution. Final securing of the structure called the orbital complex is completed over the Pacific.

Monitoring cosmonaut descent from orbit is no less important. The Soyuz-TM manned spacecraft's deorbit propulsion system is fired over the South Atlantic, and the spacecraft transitions into a ballistic descent trajectory. The precise area in which the cosmonauts will land is determined from information obtained by a ship deployed in the South Atlantic. The other ships deployed along the descent path monitor this process and provide the cosmonauts communication with Mission Control.

Flight monitoring and control of the Buran space shuttle orbital vehicle are accomplished in like manner. During boost into orbit the shuttle craft's orbital engine is ignited, and the operation of this propulsion system is monitored by ships deployed in the South Pacific. A specific feature of the Buran is a gliding descent from orbit followed by a runway landing. This type of descent has a flatter trajectory than a ballistic descent and therefore takes a longer time. For this reason, for a shuttle descent ending with a runway landing, the deorbit burn takes place sooner than, for example, in the case of a Soyuz spacecraft. The Buran's orbital engine is fired for the deorbit maneuver as it passes over the South Pacific, after which the descent process commences. Monitoring of onboard systems is the same as during deorbiting of a Soyuz-TM spacecraft. Monitoring is performed by one of the "Kosmonavt Georgiy Dobrovolskiy"-class space service ships deployed in the South Pacific.

With a gliding descent it is very important to monitor orbital vehicle entry into the atmosphere. This information is provided by ships deployed in the Central Atlantic and in the Mediterranean. It is above these areas that the craft descends to an altitude at which the atmosphere exerts aerodynamic drag. The same means are used to monitor this segment of a Buran mission as are used for Mir space station control, since the ships' operational areas practically coincide.

We should note that the Buran orbital vehicle is also capable of conducting exchange of all information with Mission Control via a Luch geostationary communications relay satellite when within the latter's line-of-sight.

Thus the space service ships help eliminate communications "dead spots" and help provide monitoring and control of space vehicles during the entire mission.

Soviet Shuttle Craft Systems Reliability Testing

90R10007R Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 10, Oct 89 (signed to press 12 Sep 89) pp 44-45

[Article, published under the heading "Space Flight Support," by Candidates of Technical Sciences V. Bocharov, V. Vorobyev, G. Dementyev, and B. Chalyy: "Making the Buran Reliable"]

[Text] Chernobyl, Challenger, Chernovtsy.... These words, which begin with Ch, are today akin to a fourth term, the abbreviation for which—"ChP" [Serious Accident]—is well known to all of us. Indeed, the events connected with the above were of national scale as concerns environmental, economic, and moral detriment. Each of them was a consequence of manifestation of a certain aggregate of violations of or deviations from operational procedures. But what is remarkable is the fact that a single violation or deviation, taken separately, did not constitute a serious danger, and this created the illusion of reliability. This resulted in unconcern and complacency. It is these latter which led to the fatal inevitability of disaster.

The authoritative boards of inquiry which investigated the causes of the tragedy drew up measures to prevent them from occurring again.

Naturally the first question they addressed was the following: is it not possible to determine such dangerous combinations of mistakes and deviations, taking appropriate measures before they actually occur? In other words is it possible to guarantee safety in advance?

The people who designed the Buran selected precisely this approach.

In general terms, when designing and building each device or subsystem, the designer pays close attention to ensuring reliability, being well aware of the consequences of equipment malfunctions and failures. But even the layman understands the potential consequences to the Buran space shuttle of such things as separation of heat tiles or failure of the gear to extend on landing. From this it is clear that overall flight safety is made up of the operational reliability of the subsystems.

Until recently, however, these matters were determined by and large at the level of the initiative and competence of each individual developer. They were not reinforced by scientifically-validated methods, means, and mandatory rules and procedures. Engineering design results remained the property of their individual authors and were not analyzed at the "man-machine-environment" large system level, with the involvement of the manufacturing and servicing people, which failed to ensure full evaluation and adequate measures to prevent dangerous phenomena from occurring. And as already noted, such phenomena are manifested in the form of an aggregate of deviations from normal operation by a number of subsystems. Such sets of deviations should be considered chance occurrences in the full meaning of this philosophical category.

A fundamentally new problem applicable to large systems has arisen, for example, consisting in the ability to predict chance or random phenomena and to prevent such phenomena before they are manifested during operation. Probability theory, which investigates chance or random events, and reliability theory, which makes it possible to design and build items which function flawlessly through the course of a specified period of time, formed the basis of problem solution.

Both theories make it possible most fully to determine potential variations of random phenomena and the frequency of their recurrence. But chance cannot be totally eliminated, no matter how small its probability. Thus a new theory—theory of flight safety—came into its own.

Its methodology was formed in aviation back in the 1970's, both in this country and abroad. This theory made it possible to improve flight safety severalfold in Civil Aviation, in which accidents connected with equipment failure take place today at an average interval of tens of millions of flight hours.

The main requirement is a safe and satisfactory mission completion with the stipulated number of changes in the status of onboard systems, that is, maintenance of system operational condition and status following occurrence of an allowable number of malfunctions. This is achieved by incorporating various forms of redundancy (structural, functional, informational, strength, etc) into the vehicle's design and by crew preparedness to perform flight control functions with a sudden systems reconfiguration. This redundancy should prevent not only possible changes in the condition and state of the structure, as a rule dictated by the level of reliability of its component parts, but also unintentional mistakes made during manufacture, operation and maintenance of the craft, the manifestation of which cannot be eliminated, especially prior to commencement of flight testing.

As applied to the Buran, during the flight of which continuous monitoring is performed from mission control, redundancy enables not only the crew but also operator personnel at the flight testing ground control facility to detect in a prompt and timely manner the initial onset of random occurrence (the first elements in a dangerous chain of events—an aggregate of operational errors or deviations), to prevent such occurrence from taking the crew by surprise, and to slow development to a state where there occurs a fatal inevitability of loss of the craft.

For this reason the following additional condition for a safe outcome appeared—monitoring of system state and condition as the flight progresses. In order to meet this condition it was necessary to develop an automated system for collecting, processing, and analyzing flight data, with automatic recognition and identification of a specific type of incipient abnormal situation and formulation of recommendations for action in the current conditions. Such a system is essential for the Buran space shuttle during deorbit, when only seconds are available for reaching a decision.

Finally, it has been acknowledged as essential, in addition to the measures indicated above, to provide for an extreme measure—safe destruction of the craft with no danger to those in the vicinity, while ensuring prompt and timely crew ejection.

The Buran, which combines the properties of an orbital vehicle and an airplane, presented designers with a number of qualitatively new problems pertaining to ensuring mission safety.

The objective was to reduce the risk of an in-flight emergency or accident to a minimum not only by technical means by also by organizing the work efforts of the large team of designers, builders and testers, who number in the thousands.

Organization of these efforts was grounded on a special integrated flight safety program, designed to control all types of operations at the stages of design, manufacture, testing, and operation. It provides for a phase-by-phase sequence, continuity, promptness and timeliness of performance of all planned and scheduled types of monitoring and testing, with a specific individual responsible at each phase for the extent and reliability of work

performed, and work timetable. This approach enabled the numerous entities involved in the project to sequence operations and establish strict monitoring of reliability of results with a unique volume of scheduled work activities aimed at ensuring flight safety with the unmanned version.

In order to achieve this, the experimental design offices and scientific research institutes defined three multidimensional regions of possible functioning of the Buran. The first was the region of normal operation of Buran and its component parts. The second was characterized by a stipulated number of changes in the state of onboard systems which diminished the level of their operating condition and status but whereby landing was assured. In the third region a safe completion of the flight became questionable.

In establishing the boundaries of the region of normal operation, maximum allowable values of flight performance characteristics, stability and controllability characteristics, parameters of electromagnetic compatibility, properties of materials, vibration stresses, and other restrictions observance of which was considered mandatory were adopted as initial standards. They were obtained from the results of basic research and synthesis of aggregate experience in operation of aerospace hardware. Conformity between the operating parameters of onboard systems and the specified standards was considered one of the basic conditions for ensuring flight safety.

In order to check their observance, branch institutes drew up Flight Safety Standards, which comprised a summary of more than 800 requirements on onboard systems, as well as on performance characteristics, electromagnetic compatibility, fire and explosion safety, equipment protection against explosion, protection against lightning, protection against static electricity, plus other shuttle craft characteristics and properties. Methods of estimating conformity with Flight Safety Standards were devised at the same time.

The experts were faced with an unusually complex task when examining the Buran's flight in the second region. They were to establish not only a list of possible causes of state change but also to determine optimal ways and means of safely completing a mission when parameters transition into that region. This work was based on analytic investigations confirmed by results of mathematical and full-scale simulation. In view of the various forms of redundancy characteristic of the majority of Buran components, they were conducted to a depth of up to three possible independent state changes in the component under analysis.

New methods of analysis for systems of various category were devised in the process of investigation, methods which were designated operation-by-operation analysis and transformation of information flows. The first method was grounded on analysis of the effect of possible state changes on operations performed by hydraulic systems and discrete-action systems; the second was based on investigation of analogous effects on the content of information flows, occurring between information system components of various hierarchic level.

At the first stage of analysis a model is devised which reflects actual properties, linkages, and interactions of the target system with linked and external conditions. At the second stage possible kinds of system states were formed, transition to which is caused by malfunctions or failure of system elements. At the third stage lists of abnormal situations were drawn up, situations caused by system state changes, abnormal situation threat categories were determined, and methods of countering such situations were devised.

The total number of synthesized elements obtained as a result of structural degradation ran as many as 400 for the majority of systems, while the number of possible types of states was as many as 100, with a total number of elementary measured states as many as 10,000. The number of abnormal situations which could occur due to failure of from one to three system elements as a rule totaled at least 50.

Analytical investigation results were tested under experimental conditions. More than 400 types of malfunctions and failures were simulated on test benches in order to determine precise boundaries between types of state. More than 1,000 variations of orbital vehicle control movement were investigated in the process of development in order to determine category of situation and to draft recommendations on remedial actions. This entire complex of investigations made it possible to obtain a fairly precise quantitative and qualitative description of orbital vehicle operation in the safe operating region, separating it from the third region.

As a rule several forms of redundancy were used to increase flight safety during the simultaneous effect of several adverse factors. In a number of instances, however, the safety margin was the sole saving factor. There were comparatively few such components, and they were isolated into a category of particularly critical components, with special conditions of design, manufacture, testing, and operation.

All experimental work was done within the framework of the Integrated Program. The following figures indicate the volume and extent of this work. Large integrated circuit failure testing aboard flying laboratories totaled 5.5×10^6 hours, while testing of medium and small integrated circuits totaled 4.5×10^6 and 1.27×10^7 hours respectively. Particularly tough testing conditions were provided for the Buran's highly-critical systems.

The work conducted to date will unquestionably require further improvement of methodology of ensuring mission safety. We can already acknowledge, however, that a system of warrantied contractual (agreed-upon) levels of mission safety and reliability of complex systems was drawn up and certified in the process of developing the Buran. Although this system was devised taking into account the specific mission and operation of the Buran,

it is based on general technical principles. In connection with this it can also be applied in other areas of the economy where multifunction and complex systems are in use.

Problem With Soviet Ejection System Component Failure

90R10007S Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 10, Oct 89 (signed to press 12 Sep 89) p 46

[Article, published under the heading "A Reader States a Problem," by Lt Col V. Vasilyev: "Making It Through To... Repairs"]

[Text] **A MiG-29 crashed during a demonstration flight at the Paris Air Show on 8 June 1989. It was later ascertained that the accident had been caused by ingestion of a bird into the starboard air intake. But test pilot A. Kvochur escaped unharmed. He ejected two seconds before the aircraft struck the ground and exploded. Thus the K-36 standardized ejection seat designed by G. Severin was "demonstrated." This ejection seat, the world's leading aviation experts acknowledge, is superior in performance to the best Western systems.**

* * *

While giving due credit to the pilot's skill and composure, we should note that his life was saved by the aircraft emergency ejection system (SAPS) which, as paradoxical as it may seem, itself can become a source of hazard when operated with carelessness or ignorance.

At the present time the safe, reliable K-36 standardized ejection system is used on Soviet military aircraft of many types. This ejection system has assisted many crewmembers in a difficult situation. It is for good reason that pilots say that this ejection seat is their guardian angel. But it has one weak point: there occur instances of splitting of the rubber grips at the base of the ejection handle, caused by alternating bending loads.

Measures have been devised to correct this problem, calling for replacing the rubber ejection handles with polyurethane ones. These replacements are made when a K-36 comes in for maintenance, regardless of condition of the ejection handles. In addition, guideline documents prescribe that if splits appear, the handles must be replaced immediately, while in operational use.

As strange as it might seem, however, some Air Force personnel have a cavalier attitude toward operation and maintenance of this unique piece of equipment. For example, analysis of the condition of the ejection handles of ejection seats coming in for routine maintenance indicates that this requirement is not always met by engineer-technician personnel. Ejection seats are coming in for maintenance with handles containing grips with splits clear through the rubber in the base area, cracks

Diagram of ejection handle.

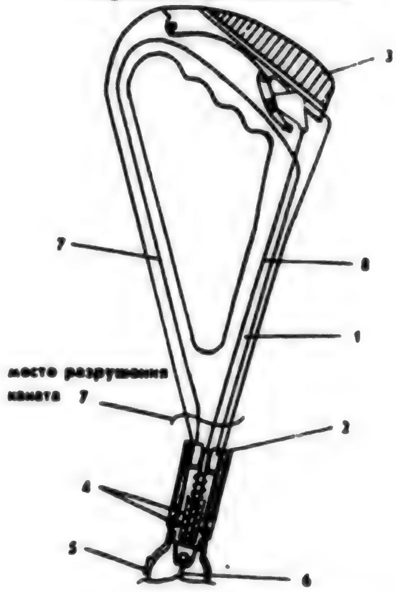


Схема ручки управления катапультированием.

Key:
7. Cable failure site

which maintenance personnel for some reason consider to be a problem which does not require immediate correction. In addition, in violation of all regulations, attempts are made to repair rubber grips by wrapping with duct and electrical tape in order to... "make it through" to the next scheduled maintenance.

In our opinion this attitude to such an equipment problem is due to a lack of responsibility as well as inadequate knowledge of equipment design and construction. This is an absolutely wrong attitude and is fraught with serious consequences. The system could activate at the most inappropriate moment: during takeoff, or in the hangar.... The fact is that in some cases the presence of deep, clear-through splits in the handle grips leads to failure of the steel cable strung through the grips to provide greater rigidity. And this causes impairment in the condition and status of the ejection handle as a whole. How does this happen?

Let us examine the construction and operation of the ejection handle (see diagram). It consists of two rubberized grips (1) joined to a base (2), locking levers (3), ball locking device (4), ejection control mechanism head (5), and steel control cable (6). Steel cables (7) are built into each grip in order to make them more rigid.

When one (or both) locking levers is squeezed, the ejection handle ball lock is released by an upward pull on actuating cable (8), unlocking the ejection handle so that it can be pulled out, triggering the ejection system.

When through splits develop on the ejection handle grips, alternating bending loads which occur in the process of aircraft operation are fully absorbed by steel cable (7). The steel cable ultimately breaks down from these stresses and is unable to perform its function of stiffening the handle grip. As a result the ejection handle can spontaneously withdraw without squeezing the locking levers. The fact is that force is transferred over to actuating cable (8) due to stretching of the rubber of the grip (grips), and this cable controls ejection handle unlocking. The lock releases, no longer preventing the ejection handle from being pulled out and activating the ejection system. It has been experimentally determined that upon failure of steel cable (7), spontaneous withdrawal of the ejection handle without squeezing the handle locking levers occurs with a force of 20 kg or less.

Thus such a seemingly insignificant problem as cracking of the rubber in the K-36 ejection seat handle grips can lead to serious consequences. Thorough knowledge of the design and construction of complex modern equipment and precise adherence to equipment operating and maintenance requirements constitute a guarantee of timely prevention of such consequences.

Ultralights Being Considered For Combat Applications

90R10007T Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 10, Oct 89 (signed to press 12 Sep 89) p 47

[Article, published under the heading "Aircraft Equipment Abroad," by Candidate of Technical Sciences F. Sklyanskiy, State Prize recipient, and design engineer M. Tetyushev, pilot: "Ultralight: Worker or Warrior?"; based on materials in foreign publications]

[Text] Some new names began popping up in foreign publications at the end of the 1970's and beginning of the 1980's: ultralights, ultralight homebuilts, and ultralight aircraft [ultralayty, ultralegkiye apparaty (ULA), sverkhlegkiye apparaty, samodelnyye letatelnyye apparaty (SLA), sverkhlegkiye i ultralegkiye samolety (SLS, ULS)]. As we see, the terminology is still in a state of flux, but these terms signify revival from oblivion by the lightplanes of the 1930's and earlier in the development of aviation.

The appearance of the hang glider—the simplest of all presently-known flying machines—served as an impetus for the development of today's ultralights. On a hang glider the pilot is positioned horizontally on a special hang mounting under the wing, which is formed by stretching film or fabric across a frame. Control is accomplished by the balance method: shifting the craft's center of gravity relative to the wing.

At first hang gliders simply glided from a height, just as Otto Lilienthal did many years back with his gliders. Subsequently hang glider enthusiasts mastered flying in mountain terrain and in ascending air currents. Later a small motor was added to the hang glider, which turned it into a motorized hang glider, capable of taking off from a small, flat (no incline) area, of climbing without the assistance of ascending air currents, and of accomplishing level flight in any direction.

A lightweight three-wheeled carriage was developed to facilitate takeoff and landing. This made it possible to place the pilot in a more comfortable seated position. This increased flying comfort and safety.

The paraplane became a variation on the ultralight aircraft. A carriage with motor and pilot's seat is suspended from a modified parachute, which generates lift during translational motion.

Another path taken in the development of ultralights is the designing of maximally simple, lightweight, small aircraft, using well-known layout configurations. Their wings are rigid, with conventional internal framing and skin top and bottom. The fuselage is replaced by a space truss (without skin) or simply by a tube with a lightweight fairing. The tailfin and landing gear are maximally simplified, and control is accomplished by control surfaces operated from levers mounted in the cockpit.

The homebuilt ultralights which appeared in the 1970's were initially intended exclusively for sport and recreation. As they became more sophisticated, however, conditions were created for these aircraft to be put to practical use. Tests confirmed that they can perform many tasks, first and foremost search and surveillance, transport of small payloads, and performance of aerial photography. Thanks to advances in aerodynamics and development of new, higher-strength materials, good results have been obtained in speed, payload capacity, takeoff and landing performance with small gross takeoff weight and moderately-powered motor.

The excellent performance characteristics and economic indices of modern ultralights have attracted the attention of the experts, since these simple and inexpensive aircraft, fabricated of tubing and plastic film, can produce unique performance characteristics about which until quite recently one could only dream.

Only from 20 to 40 meters of relatively flat surface is required, for example, for such an ultralight to take off and land, while the load ratio (payload as a percentage of gross takeoff weight) runs as high as 65-70 percent. Another valuable characteristic is the fact that these devices can be packed into a small container for transportation, and it takes only 20-30 minutes to reassemble them for flight. Their slow speed makes it possible to fly them in poor visibility and in adverse weather. And, finally, simplicity of flying these aircraft is another attractive feature. A pilot can be trained in from 20 to 25 hours.

The excellent performance and low operating costs of ultralights have fostered their rapid growth. Both veteran

aircraft companies in many countries as well as newly-established companies have begun designing and building these aircraft. Today their numbers exceed 10,000.

Analysis of the designs of modern ultralights indicates that in spite of the simplicity and low cost, preference is still given to conventional aircraft designs, with the pilot shielded by a nose fairing or almost entirely enclosed cockpit. This is connected not only with improving pilot comfort but also an endeavor to improve aerodynamics, to remove a psychological obstacle to a nontraditional mode of control, and to increase pilot safety in case of collision with an obstacle.

According to reports in foreign publications, development abroad of military versions of ultralight aircraft commenced at the beginning of the 1980's. Military experts were particularly attracted by such features as modest requirements as regards basing conditions, mobility, air assault capability, low noise during motor operation and practically no noise when the motor is switched off, capability to fly at extremely low level, difficulty of detection by radar, and low cost. In their opinion mobile subunits tasked with the conduct of visual and photographic reconnaissance, liaison and communications, combat patrolling, and conduct of military transport, search and rescue, and medevac operations should be equipped with ultralights. Military experts have also considered variations of direct combat employment of ultralights for artillery fire adjustment, target illumination (including laser), ground-attack actions, and even engagement of enemy helicopters. Both modified recreational ultralights and specially designed ultralights would be used for these missions, fitted with appropriate gear and light armament, illuminating, laser, and photographic equipment, machineguns, rocket-propelled grenade launchers, small bombs, rockets, and mines. One U.S. company, for example, has suggested two of its ultralights for the military: the single-seater Rally Sport and the two-seater Rally 3. The Rally 3, which in regular production, can carry a payload of up to 100 kg, which for military requirements would have to be boosted to 227 kg, with a range of up to 370 km at a speed of 72 km/h. According to requirements specified by the U.S. military, such an aircraft should have a ceiling of at least 3,050 meters, be transported in containers with capability of assembling to a combat-ready state in field conditions by two technicians in not more than 30 minutes, and should possess rough-field capability. According to a statement by the president of the Rotec Company, published in the press, U.S. ultralight requirements will total at least 1,000 units.

According to reports in foreign publications, the U.S. military is working on development of a one-man motorized ultralight with a parachute-type wing (paraplane). Such an aircraft would be used to conduct special operations, such as hostage-rescue actions. Lockheed C-141 strategic military transport aircraft would be used to deliver them to the launch site. Work is also in progress on reducing the radar signature of ultralight aircraft by replacing metal structural components with composite materials. Toward this same end they are planning to use special piston engines manufactured with maximum utilization of ceramic materials.

A canard-design single-seat ultralight ground-attack aircraft, the R3 Rattler, has been developed in Great Britain, a design similar to the well-known American Aerolights Falcon. This ultralight would carry a 7.62 mm machinegun and 200 rounds of ammunition. Underwing pylons could carry up to 14 50 mm rockets, antipersonnel mine dispensers (144 mines), or chaff dispensers. This aircraft has a range of 1,100 km at a speed of 145 km/h.

In February 1985 France commenced test launches of antitank rockets from a Baroudeur two-seater ultralight. Calculations by experts indicate that with an outlay equal to the cost of a single fighter, 1,200 rocket-armed Baroudeur ultralights would be able to double the firepower of a modern division.

Initial testing of combat ultralights has also been performed in the FRG.

Thus it is evident even from a very brief survey of materials contained in foreign publications that in recent years military-function ultralights have undergone intensive development. They are rapidly being transformed into a new and effective type of weapon.

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